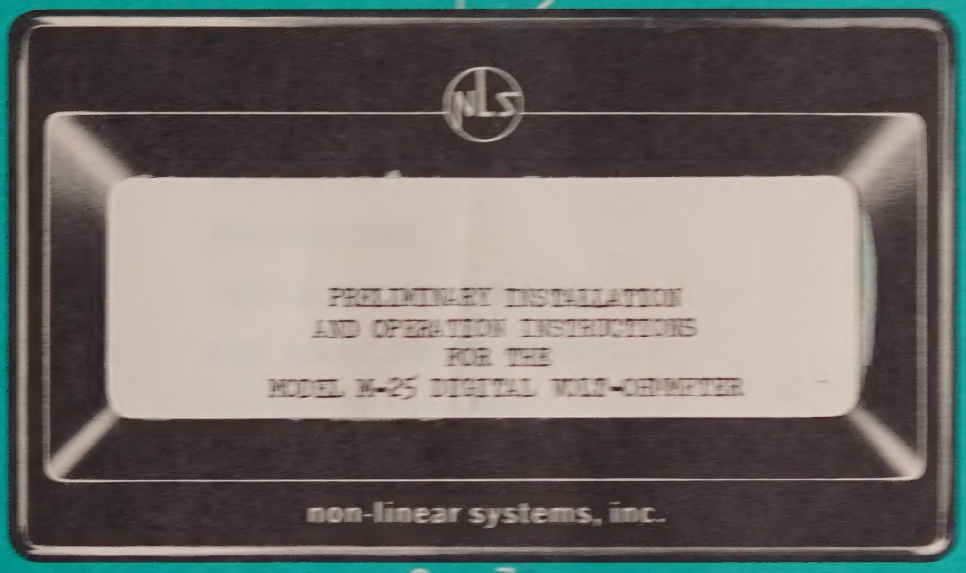

non | linear
systems, inc.

DEL MAR, CALIFORNIA

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February 1962

PRELIMINARY INSTALLATION AND OPERATION INSTRUCTIONS FOR THE MODEL M-25 DIGITAL VOLT-OHMMETER

NON-LINEAR SYSTEMS, INC.

Del Mar, California

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LIST OF SCHEMATIC DIAGRAMS

10070 Sheet 4	CABLING DIAGRAM
	"A" UNIT
10070-009	MAIN BOARD
10070-011	DECADE
10070-013	6 STAGE COUNTER
10070-015	RANGE-FUNCTION
10070-017	POLARITY-DECISION
	"B" UNIT
10070-109	MAIN BOARD
10070-111	POWER SUPPLY
10070-113	REFERENCE-SUPPLY
10070-115	BUFFER
10070-117	AMPLIFIER-RANGE
10070-119	RECTIFIER
	CABLES
15004-075	INPUT CABLE
15004-077	EXTERNAL REFERENCE
15004-078	REFERENCE
15004-079	POWER & LOGIC

PRELIMINARY INSTALLATION AND OPERATION INSTRUCTIONS FOR THE MODEL M-25 DIGITAL VOLT-OHMMETER

SECTION I - INTRODUCTION

The Model M-25 Volt-Ratio-Ohmmeter is a five digit instrument designed specifically for systems checkout. The high accuracy, speed, and reliability of the instrument are obtained by the use of semiconductors and mercury-wetted relays. The digital measurement, including decimal, sign and function is displayed on a removable, edge lighted readout developed by Non-Linear Systems, Inc.

The logic circuits of the instrument, which are made up of germanium transistors and silicon diodes, are duplicated many times in the instrument. Because of this, it has been possible to use identical plug-in units, thereby simplifying the stocking of spare parts. Furthermore the plug-in units have been made so that the computing and readout storage of each decade is contained in one unit. This is a useful feature in diagnosing malfunction in the computing processes of each decade.

Many desirable features of other NLS digital instruments are retained in the Model M-25. These include high input impedance, automatic range and polarity selection, and the ability to operate card punches, electric typewriters, and other printing devices. The Model M-25 is also equipped for use with an NLS Model 125E AC-DC Converter if accurate AC voltage measurements are desired.

Features of the Model M-25 include:

1. Measuring rate: 1.1 sec/reading.

2. Multipurpose: measures DC volts, DC voltage ratios, and DC resistances (non-reactive).

3. Modular construction.

4. Long readout bulb life: All readout bulbs of the Model M-25 are powered by a regulated supply and switched by transistors, thus greatly limiting the surge current to a cold bulb filament.

5. Remote or local control of any or all of the following: "Scan" command, range, function, input filter.

6. Readout storage: The meter can be programmed for a new reading while the previous reading is being recorded.

SECTION II - SPECIFICATIONS

INPUT IMPEDANCE:

1. VOLTS DC - 10 megohms at balance, 900K, minimum.
2. RATIOS - 1000 megohms low range at balance.
3. K-OHMS - Does not apply (input is one leg of a Wheatstone).

REFERENCE:

1. VOLTS DC - Internal, temperature controlled, zener-diode-stabilized reference source.
2. RATIOS - External ± 10 VDC minimum to ± 100 VDC maximum (Ripple content should be less than .001% of the Reference.).
3. K-OHMS - Internal, -24 V.

RANGES:

VOLTS DC, Manual and Automatic Range Selection

a.	± 0.0000	- ± 9.9999 VDC
b.	± 00.000	- ± 99.999 VDC
c.	± 000.00	- ± 999.99 VDC

RATIO, Manual and Automatic Range Selection

a.	± .00000	- ± .99999
b.	± 0.0000	- ± 9.9999
c.	± 00.000	- ± 99.999

K-OHMS, Manual and Automatic Range Selection

a.	0.0000	- 9.9999 Kilohms
b.	00.000	- 99.999 Kilohms
c.	000.00	- 999.99 Kilohms

VOLTS AC, Manual and Automatic Range Selection

a.	0.0000	-	0.9999
	1.0000	-	9.9990
b.	00.000	-	09.999
	10.000	-	99.990
c.	000.00	-	099.99
	100.00	-	999.90

ACCURACY

VOLTS DC: ± (.01% of reading + 1 digit)

RATIO: ± (.01% of reading + 1 digit)

OHMS: ± (.01% of reading + 1 digit)

Screwdriver-type calibration controls permit bringing instrument into agreement with user's standards.

PRIMARY POWER

115V ± 10V AC at 60 cps with earth ground available.

OPERATING TEMPERATURE

+32° F. to +125° F., ambient.

SECTION III - INSTALLATION AND OPERATION

GENERAL:

The Model M-25 digital multi-purpose meter consists of two modules, each 5-1/4" high and designed to be installed in a standard 19" rack or cabinet. Each module is completely enclosed and can be operated on the bench.

The logic module (or "A" unit) contains a mercury-wetted contact-relay-operated Wolff-Poggendorf voltage divider, the transistorized logic circuits that operate it, and the readout. The power and sensing module (or "B" unit) contains the power supply, the reference source, the sensing amplifier, and range and function switching relays. This unit is identified by the control knobs on the front panel.

Special precautions should be taken as to the physical attitude of the units. Both units contain mercury-wetted relays which cannot be operated at an angle of greater than 30° off of vertical. Therefore, after installation has been completed, the front panels should be within ± 30° vertical.

Upon completion of installation, check to see that there is sufficient clearance or air flow for convection cooling.

CABLE CONNECTIONS:

1. Connect the following inter-connecting, input, and control cables to the "A" and "B" units.

PURPOSE	PLUG IDENTITY	LOCATION
Power and logic	50 pin Winchester	A unit to B unit
Feedback	5 pin "AN" Connector	A unit to B unit
External Reference	4 pin "AN" Connector	B unit to external reference volts
Input	3 pin "AN" Connector	B unit to unknown input
*Printer Intelligence	75 pin Winchester	A unit to print device of remote readout
**AC-DC-Converter Control	34 pin Winchester	B unit to AC-DC Converter

*This cable is supplied only with a printer, adapter, or remote readout; otherwise a plug is supplied which can be wired to a recording device.

**This cable is supplied only with an AC-DC Converter; otherwise, a plug is supplied which can be wired to provide remote function control, as shown in Figure 1.

2. Connect the input cable to the input as follows:

Red clip (Pin A) to high-impedance side of signal to be measured.

Black clip (Pin B) to low-impedance or ground side of signal to be measured.

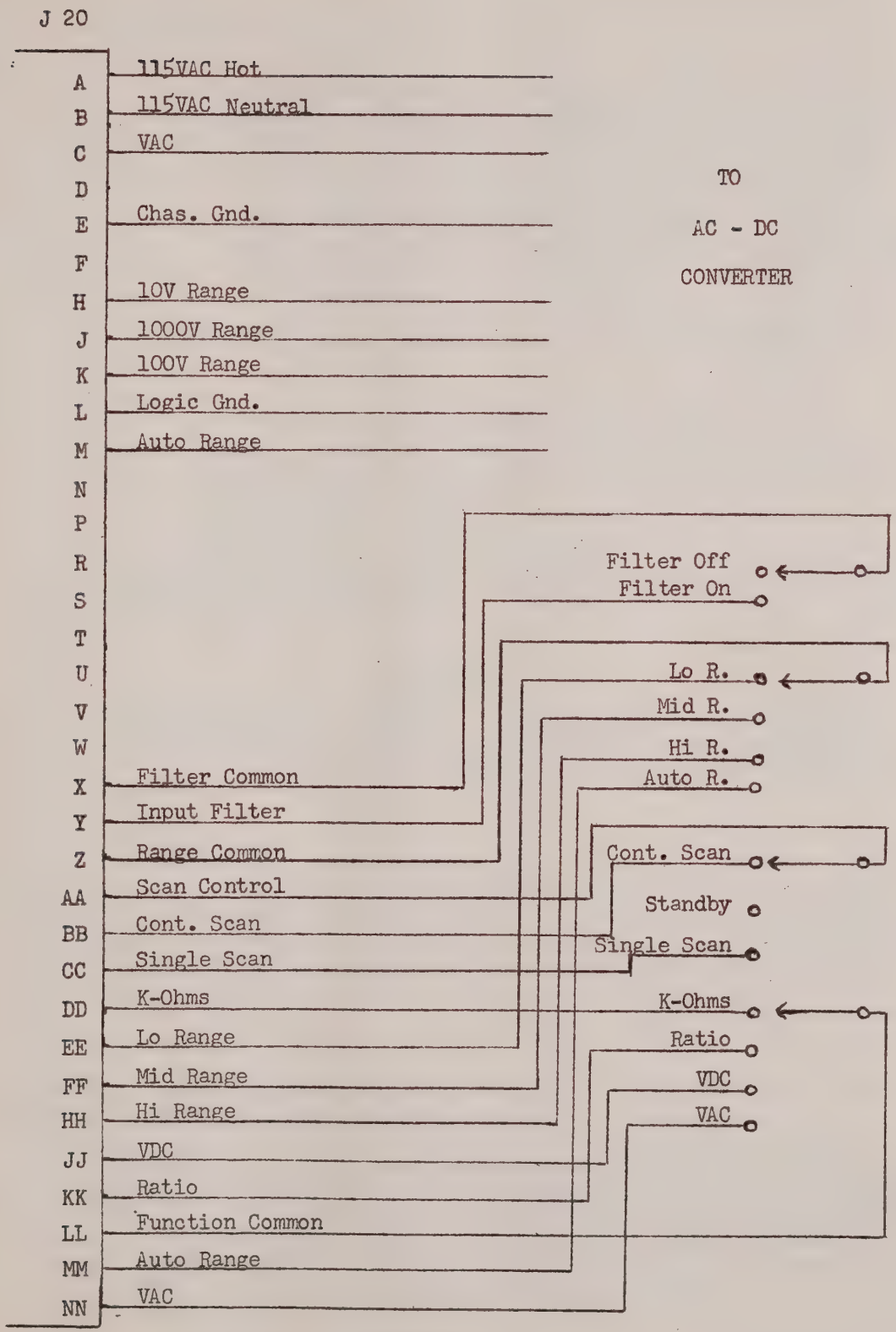


FIGURE 1
M-25 REMOTE CONTROL CONNECTIONS

Uninsulated clip (Pin C) to shield or chassis of the signal to be measured. The meter will operate best, if the black clip and the uninsulated clip are connected together. However, this is not always possible, since the uninsulated clip is tied to the chassis of the instrument and to the line power ground. It is necessary that less than 100 millivolts of AC exist between the black and the uninsulated clips when any measurement is being made.

3. Connect the external reference cable to the reference voltage, as follows:

Red clip (Pin A) to + voltage.

Black clip (Pin C) to reference ground (reference common).

Red-black clip (Pin B) to - voltage.

The reference voltage can be any magnitude from ± 10 VDC minimum to ± 100 VDC maximum. Loss of accuracy will result if these limits are exceeded.

CAUTION:

Do not connect the external reference, or have the POWER switch "ON" if the "A" or "B" units are not in the proper operating position. The external reference supply and/or the "B" unit may be damaged.

PRIMARY POWER:

The Model M-25 is designed to operate from a 105 to 125 volts 60 cps power source. The instrument is supplied with a polarized power cord to utilize earth ground. It is important that the polarization of the power receptacle is correct and that earth ground is present. In all model, earth ground of the power cord is connected to the chassis ground of each module.

FUSING:

The Model M-25 is provided with four active fuses. There are also four spare fuses located adjacent to the active fuses.

1. The line fuse is located at the rear of the "B" unit. The line fuse is a 3AG slo blo rated at 1 ampere which protects the instrument from high voltage, line overload, and/or shorts. When using an AC-DC converter this fuse and its spare should be replaced with 2 amp fuses. Two extra fuses are mounted inside the "B" unit on the rectifier assembly for this purpose.

2. The power supply fuses are 2 amp slo blo 3AG type. They are located inside the "B" unit on the rectifier assembly.

FRONT PANEL CONTROLS

POWER SWITCH:

1. Controls the 115 VAC 60 cps primary power to the instrument. Power is applied to the instrument for both "ON" and "PRINT" positions.

2. Controls the print command pulse and printer operation as follows: When the power switch is in the "Print" position, a 16 millisecond pulse (-15 VDC at up to 1 m.a. load) occurs at the end of the meter scan (the pulse appears at Pin #49 of the 75 pin connector at the rear of the "A" unit). This pulse is utilized to actuate the print recording device. Quiescent voltage is approximately - .5 VDC. Also, on the "Print" position, a momentary single-pole double-throw contact closure must occur in the printer to operate the meter in "Continuous" mode, (See description of MODE switch).

FUNCTION SWITCH:

1. Remote Position - For the purpose of transfering function control to a remote station.

2. Ohms Position - For the purpose of measuring non-reactive resistance values according to specifications.

3. Ratio Position - For the purpose of measuring DC voltage ratios according to specifications. (See INSTALLATION - Cable Connections - For Reference Voltages.)

4. VDC - For the purpose of measuring Volts DC according to specifications.

5. VAC - Measures volts AC when the Model M-25 is used with an AC-DC converter.

MODE SWITCH:

1. Continuous - This position allows the meter to scan repeatedly at a rate of 1.1 sec/reading. If the POWER switch is in the "Print" position however, the meter will not scan a second time until "End of Print" information (in the form of a momentary, 10 m.s. min., SPDT contact closure) is received from the printer.

2. Standby - When the switch is placed in this position, the meter will complete the present scan and stop until a new scan command is given by momentarily placing the MODE switch to the "Single Scan" position.

RANGE SWITCH:

1. Remote Position - For the purpose of transfering range control to a remote station.

2. Low Position - For the purpose of locking the meter in its lowest most sensitive range.

3. Mid Position - Middle range.

4. High Position - Highest least sensitive range.

5. Auto Position - Meter will automatically select the most sensitive range of the meter consistant with the input.

INPUT FILTER:

1. Remote Position - For the purpose of transfering input filter control to a remote station.

2. Off Position - Input filter inactive.

3. On Position - Input filter active. The filter consists of two cascaded L-C sections and provides 60 db attenuation at 60 cps. When the M-25 is measuring resistances, the filter is automatically disconnected.

OPERATION

After the instrument has been installed and the operator has familiarized himself with the front panel controls, proceed as follows:

1. Set the POWER switch to "Off"; the RANGE switch to "AUTO"; and the FUNCTION switch to "VDC"; the FILTER switch to "On"; and the MODE switch to "Continuous Scan".

2. Short the input leads together.

3. Connect the primary power cord to a 115 VAC 60 cps polarized outlet.

4. Set the POWER switch to "On". The readout should illuminate, and the instrument should start scanning immediately.

5. After approximately one minute warm-up time, the instrument will read out $\pm$ 0.0000.

6. Allow an additional fifteen minutes of warm-up time before making any precision readings.

7. Set the MODE switch to "Standby", the FUNCTION switch to the particular type of reading to be taken, and connect the input leads to the unknown being measured. The reading can now be made once by momentarily setting the MODE switch to "Single Scan", or repeatedly by setting it to "Continuous Scan".

CAUTION:

Damage may result if voltages greater than the following are applied to the input terminals of the instrument:

1. 50 VDC or VAC with function switch on "Ohms".

2. 300 VDC or VAC with function switch on "VAC".

3. 300VDC or VAC with function switch on "Ratio" unless instrument is in the mid or high ranges.

4. 300 VDC or VAC with function switch on "VDC" unless instrument is in the mid or high ranges.

5. Under no conditions should more than 1000 VDC be applied to the input.

CAUTION: Do not attempt to measure the 115 VAC 60 cps line voltage while on D.C. function or on VAC unless caution is taken as to the polarization of the input leads.

REMOTE CONTROL OPERATION:

1. Function Selecting: Set the front panel FUNCTION switch to the "Remote" position. If the 34 pin connector at the rear of th "B" unit is wired per Figure 1, function control of Model M-25 is transferred to the remote function switch. Any function desired can be selected by turning the remote function switch to the proper position.

2. Mode Control: Set the Mode switch to the "Standby" position. Any mode of the MODE switch can now be duplicated as follows:

   a. Single Scan Operation can be remotely actuated by a momentary closure (10 m.s. min.) of contact "A" as shown in Figure 1. Contact "A" should be opened for at least 10 ms. before reclosing.

   b. Continuous scan can be obtained by a continuous closure of contact "B" (Figure 1).

3. Range Selection: Set the front panel RANGE switch to the "Remote" position. If the 34 pin connector on the rear of the "B" unit is wired per Figure 1, the range control is transferred to the remote range switch. Any range desired can be selected by turning the remote range switch to the proper position.

4. Filter Selection: Set the front panel FILTER switch to the "Remote" position. If the 34 pin connector on the rear of the "B" unit is wired per Figure 1, the input filter control is transferred to the remote filter switch. The input filter can then be turned on or off by the remote filter switch.

PRINT RECORDING OPERATION:

All of the information displayed in the readout is wired to the 75-pin connector located at the rear of the "A" unit. This information appears as a - 0.5 VDC on the pin representing the window of the readout being lit. All windows not illuminated have a quiescent voltage of - 27 VDC on their pins.

External connections to the 75-pin connector should be made using the - 27 VDC line as a common. The unit is then energized when the bulb is lit in the readout and the external load is on the readout buffer. Available current for external devices is 5 m.a. If the readout is removed, 45 m.a. (non-reactive) can be obtained. If it is desired to connect to ground as a common, the load will be in series with the readout bulb and the current will be limited to 20 m.a. However, because there are approximately 50 bulbs not lit and, therefore, a possible 50 energized loads with common ground, the load would be too great. Maximum total current from the plug should be limited to 200 milliamps.

Printing heads which plug directly into the 75-pin connector are available from NLS. Also, this type of intelligence can be used to drive an electronic serial converter for typewriters, etc.; otherwise, parallel or serial adapters, utilizing relays are used to convert the outputs from voltage representation to contact closures. The printing device is then connected to the Adapter. If the recorder has a common ground with the signal being measured by the Model M-25, a relay adapter must be used to eliminate ground loops.

With all types of printing systems, proceed as follows:

1. Connect the entire print recording system to the Model M-24. For a continuous print mode of operation, the printer being used should have a momentary SPDT contact closure, actuated for 10 m.s. (min.) when the printing is completed. This is mentioned in case the operator is using a printer other than one supplied by NLS.

2. After the instrument has been allowed to warm up, set the MODE switch to "Standby" and the POWER switch to "Print", in that order. All front panel and remote control operation remains

the same except, possibly, the "Continuous Scan" mode. It may be necessary to actuate the "Single Scan" mode O N C E before setting for "Continuous Scan" so that a capacitor in the "B" unit will charge, insuring operation of the "Continuous" mode.

Because the meter now "waits" for the printer, the scanning period will change. Therefore, depending upon the speed of the printer being used, the number of readings taken per second will drop when the operator switches to the "Print" position of the POWER switch.

REMOTE READOUT:

The 75-pin connector at the rear of the "A" unit can also be used to connect a remote readout. Model M-25 readout circuits are not designed to accommodate two readouts; so the local readout must be removed before connecting the remote readout.

SECTION IV - CALIBRATION PROCEDURE

M-25 STANDARD

Equipment Required:

1. Two voltage dividers, one with 10:1 ratio, one with 100:1 ratio; each divider calibrated for a 10 megohm load; each at least ± .005% accurate.

2. Stable but not necessarily accurate DC sources of 90 to 99.99, and 900 to 999.9 volts DC.

3. Stable and accurate to ± .005% DC source of between 9 and 9.999 volts DC. Nine standard cells calibrated for a 10 megohm load is recommended.

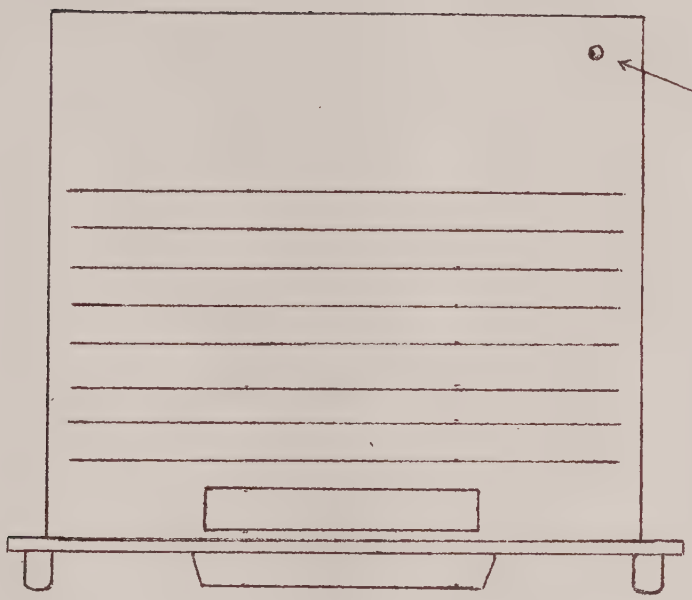
4. Stable and accurate to ± .005% resistors between 9 to 9.999, 90 to 99.99, and 900 to 999.9 kilohms.

Prodedure:

Allow the instrument to warm up for thirty minutes; remove the top covers. Follow the steps in the table in the sequence listed. The location of each adjustment potentiometer is shown in Figure 2.

STEP NO.	MODE	SOURCE	RATIO	READOUT DISPLAY	ADJUSTMENT	PURPOSE
1	VDC/AUTO	Input Leads Shorted		± 0.0000 DC	R6 (amp)	DC Offset
2R		90V	10:1	9V		
3		90V	1:1	90V	R2 (amp)	Ranging
4R		900V	100:1	9V		
5		900V	1:1	900V	R1 (amp)	Ranging
6	VDC/AUTO	9 Std. Cells	---	9V	R3 (ref)	Prime
7	1 MEG/AUTO	Input Leads Shorted		0.0000K ohms	R45 ("A" Unit)	Input Lead Compensation
8		9K ohms	---	9K ohms	R5 (amp)	Prime
9		90K ohms	---	90K ohms	R4 (amp)	Prime
10	1 MEG/AUTO	900K ohms	---	900K ohms	R3 (amp)	Prime

NOTES:
1. The readout in Steps 2 and 3 should have digital correspondence (without regard for decimal-point position) within specifications. The same requirement also applies to Steps 4 and 5.
2. "R" in the Step No. column means record the reading. The following step should show digital correspondence.
3. On Steps 6, 8, 9, and 10 the readout should agree with the calibrated inputs.



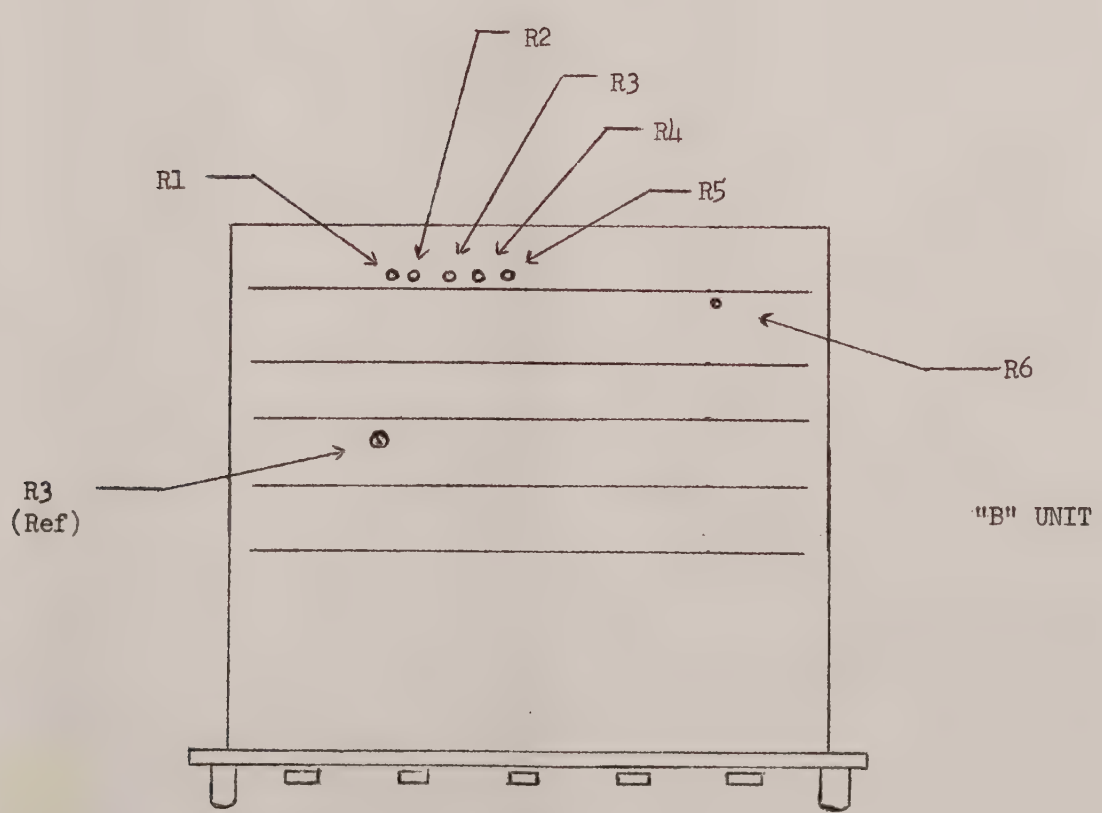
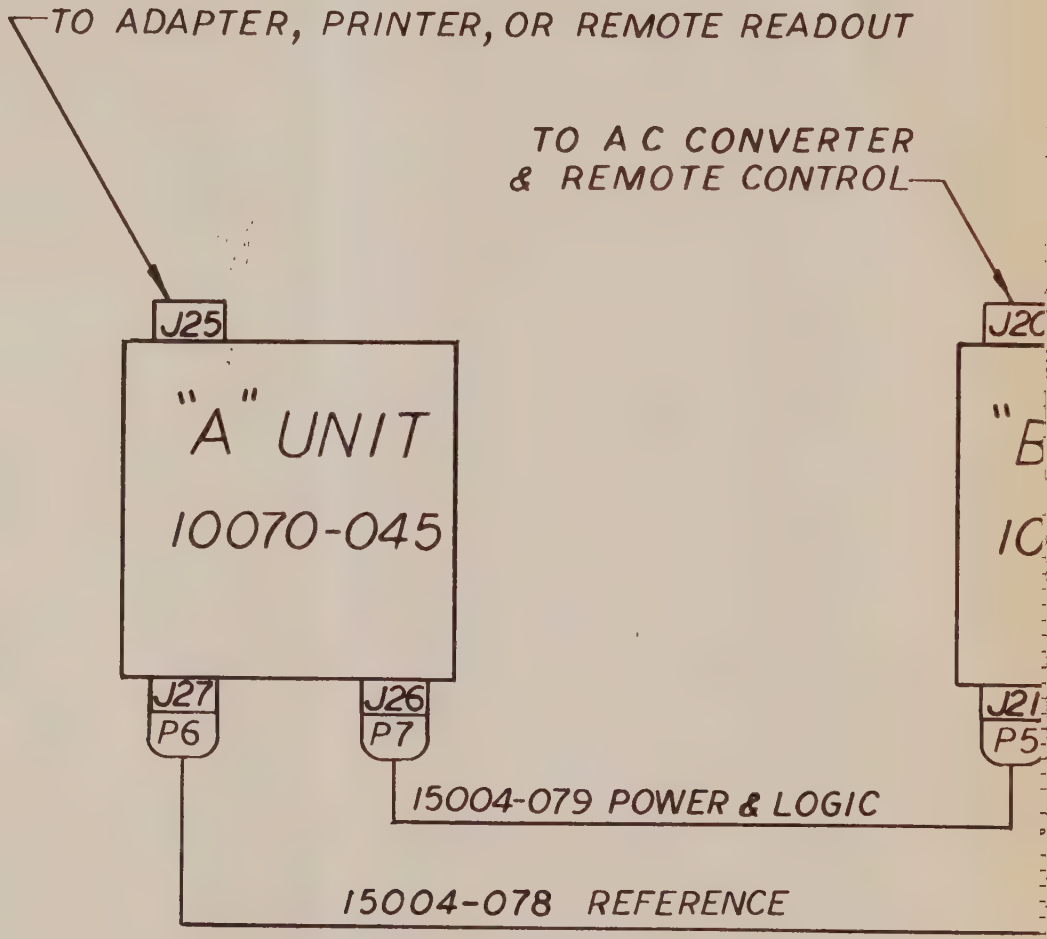


FIGURE 2
ADJUSTMENT POTENTIOMETER LOCATIONS



UNLESS OTHERWISE SPECIF

DIMENSIONS ARE IN INCHES

TOLERANCES ON

FRACTION	DECIMAL	ANG
±	±	±

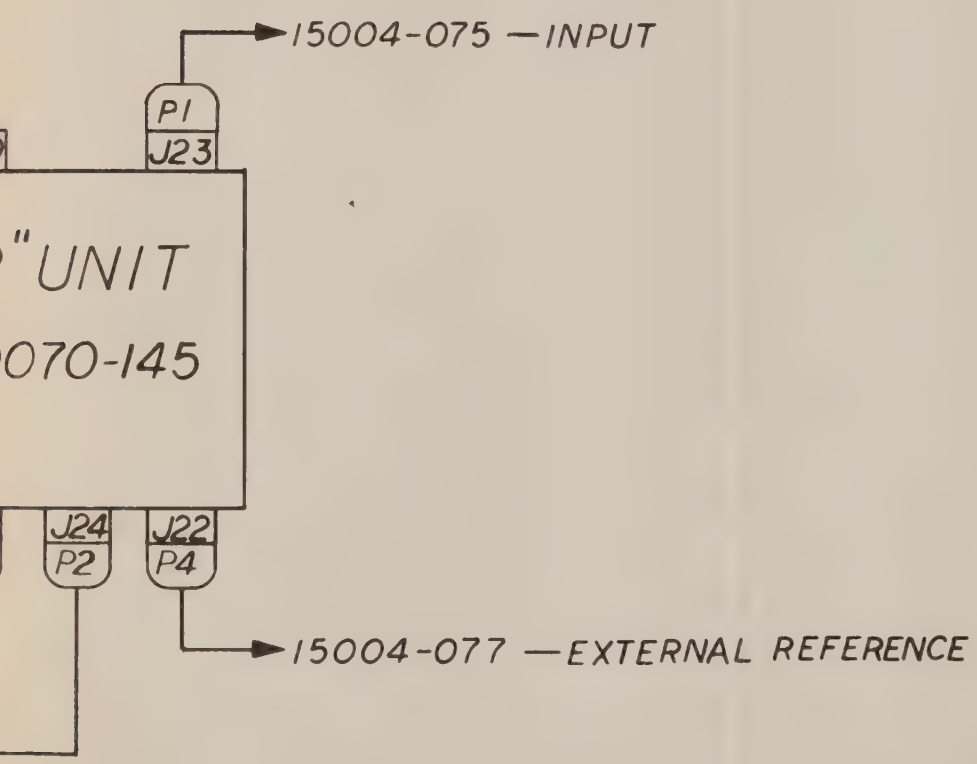
MATERIAL

NOTE

1. MATING PLUGS FOR J20 & J25 ARE SUPPLIED WITH INSTRUMENT.

10070 SHEET 4

REVISIONS				
SYM.	EFFECT.	DESCRIPTION	DATE	APPROVAL



NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

IED	DRAWN BY H. BRINLEY	DATE 2-16-62
	CHECKED BY	DATE
LES	APPROVED BY R. JOHNSON	DATE 2-21-62
	FINISH	

TITLE

CABLING DIAGRAM

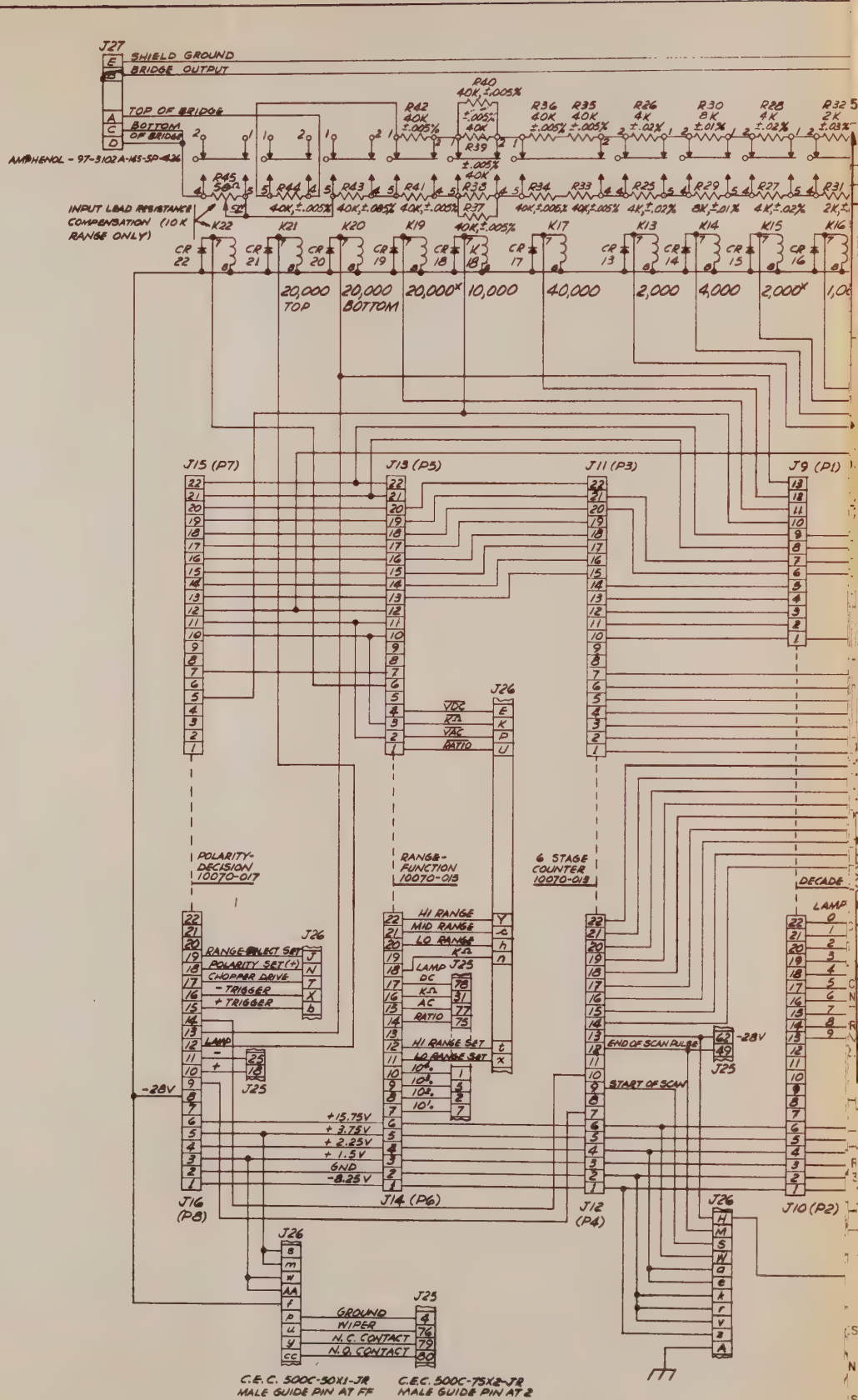
MODEL M25

SCALE | WT.

NON-LINEAR SYSTEMS INC.
DEL MAR AIRPORT
DEL MAR, CALIFORNIA

DRAWING NUMBER 10070

SHEET 4 OF


J27
SHIELD GROUND
BRIDGE OUTPUT
TOP OF BRIDGE
BOTTOM OF BRIDGE
AMPHENOL - 97-3102A-145-5P-426
INPUT LOAD RESISTANCE COMPENSATION (10 K RANGE ONLY)
R40 40K ±.005%
R42 40K ±.005%
R39 40K ±.005%
R36 40K ±.005%
R35 40K ±.005%
R26 4K ±.02%
R30 8K ±.01%
R28 4K ±.02%
R32 2K ±.03%
R45 50Ω
R44 40K, ±.005%
R43 40K, ±.005%
R41 40K, ±.005%
R38 40K ±.005%
R37 40K, ±.005%
R34 40K, ±.005%
R33 40K, ±.005%
R25 4K, ±.02%
R29 8K, ±.01%
R27 4K, ±.02%
R31 2K, ±.
K22
K21
K20
K19
K18
K17
K13
K14
K15
K16
CR 22
CR 21
CR 20
CR 19
CR 18
CR 17
CR 13
CR 14
CR 15
CR 16
20,000 TOP
20,000 BOTTOM
20,000^X
10,000
40,000
2,000
4,000
2,000^X
J15 (P7)
J13 (P5)
J11 (P3)
J9 (P1)
J26
VDC
KΩ
VAC
RATIO
POLARITY-DECISION 10070-017
RANGE-FUNCTION 10070-013
6 STAGE COUNTER 10070-012
DECADE
LAMP
RANGE SELECT SET
POLARITY SET (+)
CHOPPER DRIVE
- TRIGGER
+ TRIGGER
LAMP
-
+
J25
-28V
HI RANGE
MID RANGE
LO RANGE
KΩ
LAMP
DC
KΩ
AC
RATIO
HI RANGE SET
LO RANGE SET
10^6
10^5
10^4
10^3
+15.75V
+ 3.75V
+ 2.25V
+ 1.5V
GND
-8.25V
END OF SCAN PULSE
START OF SCAN
J16 (P8)
J14 (P6)
J12 (P4)
J10 (P2)
GROUND
WIPER
N.C. CONTACT
N.O. CONTACT
C.E.C. 500C-50X1-JR
MALE GUIDE PIN AT FF
C.E.C. 500C-75X2-JR
MALE GUIDE PIN AT 2

REVISIONS				
NO.	SYMBOL			
1		REVISED △ TYP RELAY.		

R24 200Ω ±.1% · R20 400Ω ±.1% · R22 800Ω ±.1% · R18 400Ω ±.1% · R10 40Ω ±.1% · R14 80Ω ±.1% · R12 40Ω ±.1% · R16 20Ω ±.1% · R8 2Ω ±.1% · R4 4Ω ±.1% · R6 8Ω ±.1% · R2 4Ω ±.1%

R23 200Ω ±.1% · R19 400Ω ±.1% · R21 800Ω ±.1% · R17 400Ω ±.1% · R9 40Ω ±.1% · R13 80Ω ±.1% · R11 40Ω ±.1% · R15 20Ω ±.1% · R7 2Ω ±.1% · R3 4Ω ±.1% · R5 8Ω ±.1% · R1 4Ω ±.1%

K12 CR 12 · K11 CR 11 · K10 CR 10 · K9 CR 9 · K5 CR 5 · K6 CR 6 · K7 CR 7 · K8 CR 8 · K4 CR 4 · K3 CR 3 · K2 CR 2 · K1 CR 1

100 · 200ˣ · 400 · 200 · 20 · 40 · 20ˣ · 10 · 1 · 2ˣ · 4 · 2

J7 (P1) · J5 (P1) · J3 (P1) · J1 (P1)

DECIMAL EQUIVALENT	RELAY COIL PIN 7			
	2	4	2^x	1
0	–	–	–	–
1	–	–	–	GND
2	GND	–	–	–
3	GND	–	–	GND
4	GND	–	GND	–
5	GND	–	GND	GND
6	GND	GND	–	–
7	GND	GND	–	GND
8	GND	GND	GND	–
9	GND	GND	GND	GND

NOTE: TYPICAL (4) DECADES

DECIMAL EQUIV.	RELAY COIL PIN 7				
	20,000 TOP	20,000 BOTTOM	40,000	20,000ˣ	10,000
0	GND	–	–	–	–
10,000	GND	–	–	–	GND
20,000	–	GND	–	–	–
30,000	–	GND	–	–	GND
40,000	–	GND	–	GND	–
50,000	–	GND	–	GND	GND
60,000	–	GND	GND	–	–
70,000	–	GND	GND	–	GND
80,000	–	GND	GND	GND	–
90,000	–	GND	GND	GND	GND

DECADE x 10^4 -10070-011 · DECADE x 10^3 -10070-011 · DECADE x 10^2 -10070-011 · DECADE x 10^1 -10070-011 · DECADE x 10^0 -10070-011

IDENTIFICATION OF MATING ASSEMBLIES

J25 · LAMP · J25

J8 (P2) · J6 (P2) · J4 (P2) · J2 (P2)

10070-009 REV A 1

2. ALL DIODES ARE NLS 5003-002

△ PINS 3 & 6 TYPICAL ON K1 THRU K22, WITH ALL PINS 6 COMMON.

NOTES:

DECADE 10^4 · DECADE 10^3 · DECADE 10^2 · DECADE 10^1 · DECADE 10^0 · FRONT

READOUT CONTACTS - BOTTOM VIEW
ASSEMBLY 12220

UNLESS OTHERWISE SPECIFIED · DIMENSIONS ARE IN INCHES · TOLERANCES ON FRACTION · DECIMAL · ANGLES

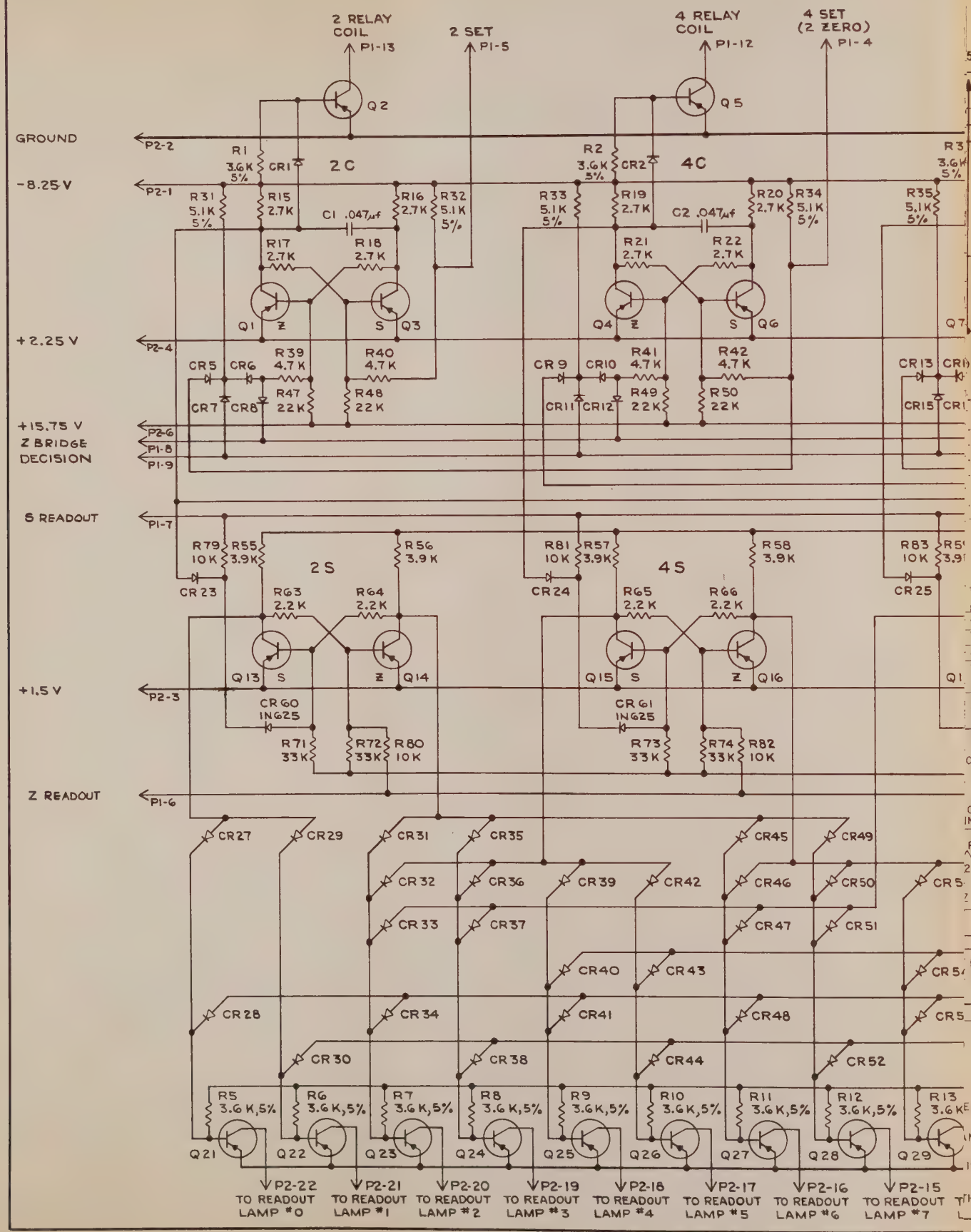
MATERIAL · FINISH

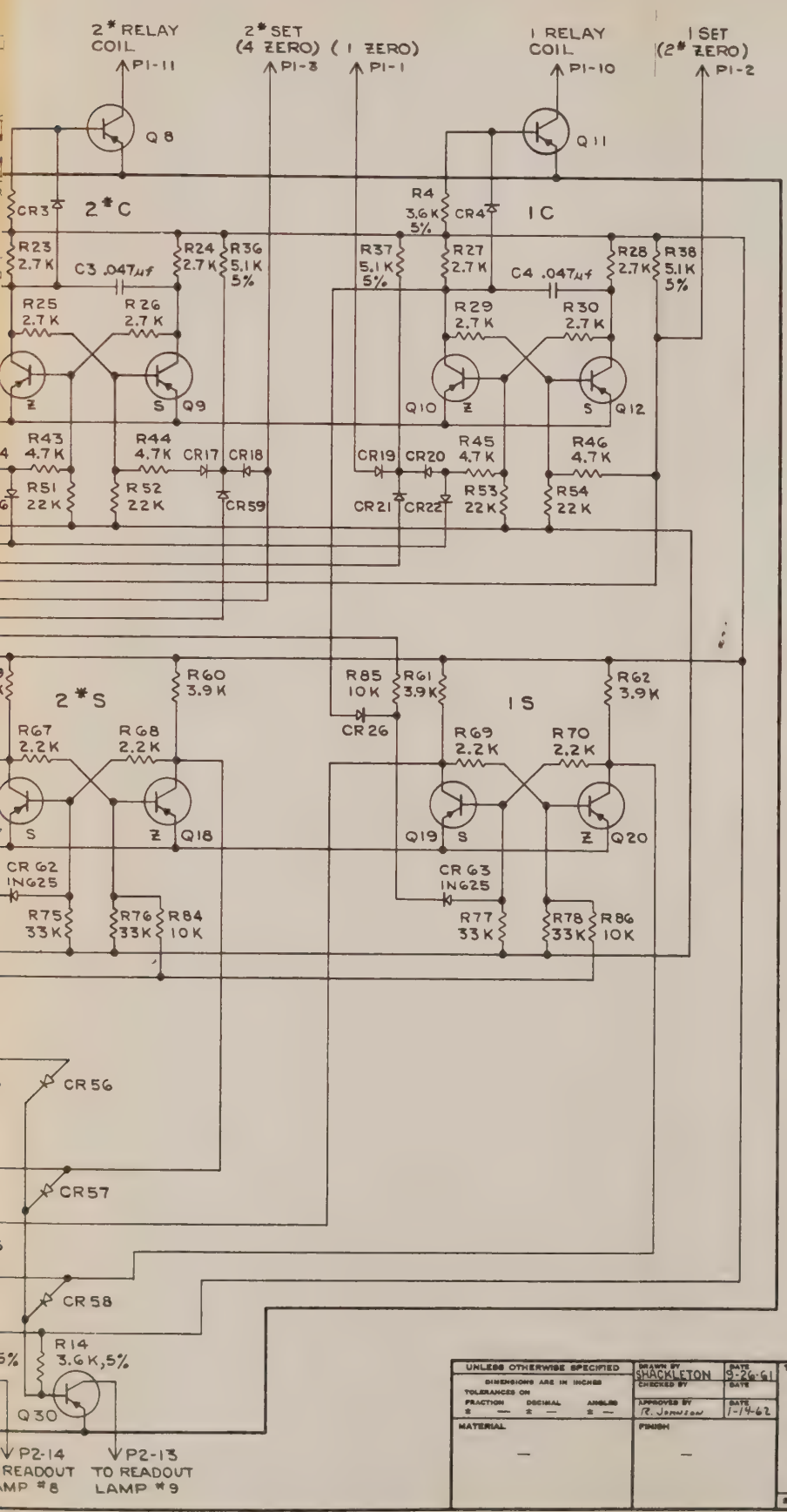
DRAWN H. BRINLEY 7-11-62 · CHECKED · APPROVED R. HAMILTON 7-11-62

TITLE: SCHEMATIC, MAIN BOARD "A" UNIT MODEL M25

NON-LINEAR SYSTEMS INC · DEL MAR AIRPORT · DEL MAR CALIFORNIA

DRAWING NUMBER 10070-009 · SCALE · SHEET 2 OF 2


2 RELAY COIL
P1-13
2 SET
P1-5
4 RELAY COIL
P1-12
4 SET (2 ZERO)
P1-4
Q2
Q5
GROUND
P2-2
-8.25 V
P2-1
+2.25 V
P2-4
+15.75 V Z BRIDGE DECISION
P2-6
P1-8
P1-9
S READOUT
P1-7
+1.5 V
P2-3
Z READOUT
P1-6
R1 3.6K 5%
CR1
2C
R2 3.6K 5%
CR2
4C
R31 5.1K 5%
R15 2.7K
C1 .047μf
R16 2.7K
R32 5.1K 5%
R33 5.1K 5%
R19 2.7K
C2 .047μf
R20 2.7K
R34 5.1K 5%
R35 5.1K 5%
R17 2.7K
R18 2.7K
R21 2.7K
R22 2.7K
Q1
Q3
Q4
Q6
Q7
R39 4.7K
R40 4.7K
R41 4.7K
R42 4.7K
CR5
CR6
CR7
CR8
R47 22K
R48 22K
CR9
CR10
CR11
CR12
R49 22K
R50 22K
CR13
CR14
CR15
CR16
2S
4S
R79 10K
R55 3.9K
R56 3.9K
R81 10K
R57 3.9K
R58 3.9K
R83 10K
CR23
CR24
CR25
R63 2.2K
R64 2.2K
R65 2.2K
R66 2.2K
Q13
Q14
Q15
Q16
CR60 ING25
CR61 ING25
R71 33K
R72 33K
R80 10K
R73 33K
R74 33K
R82 10K
CR27
CR29
CR31
CR35
CR45
CR49
CR32
CR36
CR39
CR42
CR46
CR50
CR33
CR37
CR47
CR51
CR40
CR43
CR28
CR34
CR41
CR48
CR30
CR38
CR44
CR52
R5 3.6K,5%
R6 3.6K,5%
R7 3.6K,5%
R8 3.6K,5%
R9 3.6K,5%
R10 3.6K,5%
R11 3.6K,5%
R12 3.6K,5%
R13 3.6K
Q21
Q22
Q23
Q24
Q25
Q26
Q27
Q28
Q29
P2-22 TO READOUT LAMP #0
P2-21 TO READOUT LAMP #1
P2-20 TO READOUT LAMP #2
P2-19 TO READOUT LAMP #3
P2-18 TO READOUT LAMP #4
P2-17 TO READOUT LAMP #5
P2-16 TO READOUT LAMP #6
P2-15 TO READOUT LAMP #7



REVISIONS				
SYM.	EFFECT.	DESCRIPTION	DATE	APPROVAL
1	425.1 FOW	REVERSED NOMENCLATURE P1-1 WITH P1-2.	2-9-62 MSB	2-9-62 RWJ

DECIMAL EQUIV.	COLLECTOR LEVELS Q1	Q2	Q4	Q5	Q7	Q8	Q10	Q11
0	+	−	+	−	+	−	+	−
1	+	−	+	−	+	−	−	+
2	−	+	+	−	+	−	+	−
3	−	+	+	−	+	−	−	+
4	−	+	+	−	−	+	+	−
5	−	+	+	−	−	+	−	+
6	−	+	−	+	+	−	+	−
7	−	+	−	+	+	−	−	+
8	−	+	−	+	−	+	+	−
9	−	+	−	+	−	+	−	+

NOTE: Q2, 5, 8 & 11 WILL ONLY MEASURE (−) IF THEIR ASSOCIATED RELAY LOADS ARE CONNECTED.

DECIMAL EQUIV.	COLLECTOR LEVELS Q14	Q16	Q18	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
0	+	+	+	+	GND	−	−	−	−	−	−	−	−	−
1	+	+	+	−	−	GND	−	−	−	−	−	−	−	−
2	−	+	+	+	−	−	GND	−	−	−	−	−	−	−
3	−	+	+	−	−	−	−	GND	−	−	−	−	−	−
4	−	+	−	+	−	−	−	−	GND	−	−	−	−	−
5	−	+	−	−	−	−	−	−	−	GND	−	−	−	−
6	−	−	+	+	−	−	−	−	−	−	GND	−	−	−
7	−	−	+	−	−	−	−	−	−	−	−	GND	−	−
8	−	−	−	+	−	−	−	−	−	−	−	−	GND	−
9	−	−	−	−	−	−	−	−	−	−	−	−	−	GND

NOTE: Q21 THRU Q30 WILL ONLY MEASURE (−) IF THEIR ASSOCIATED LAMP LOADS ARE CONNECTED.

10070-011
SHEET 2
1

4. ALL CAPACITORS ARE 10%, 200 VDC.
3. ALL RESISTORS ARE ½ WATT, 10%.
2. ALL DIODES ARE: NLS # 5003-002
1. ALL TRANSISTORS ARE: 2N651
NOTES: UNLESS OTHERWISE SPECIFIED

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

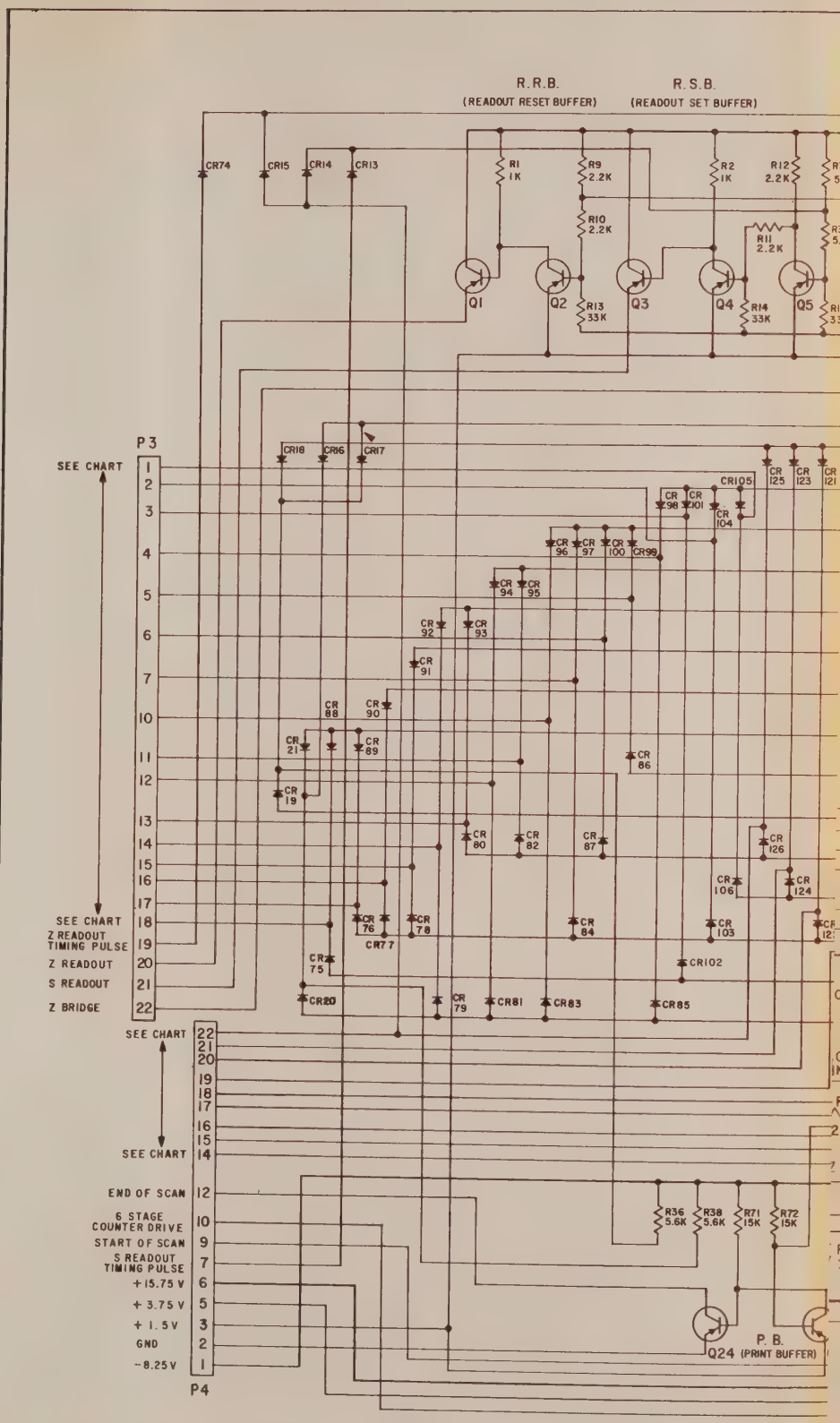
UNLESS OTHERWISE SPECIFIED	DRAWN BY SHACKLETON	DATE 9-26-61
DIMENSIONS ARE IN INCHES	CHECKED BY	DATE
TOLERANCES ON FRACTION ± DECIMAL ± ANGLES ±	APPROVED BY R. JOHNSON	DATE 1-14-62
MATERIAL —	FINISH —	

TITLE
SCHEMATIC
DECADE ASSEMBLY
MODEL 25

NON-LINEAR SYSTEMS INC.
DEL MAR AIRPORT
DEL MAR, CALIFORNIA

DRAWING NUMBER 10070-011

SCALE | WT. | SHEET 2 OF


R.R.B.
(READOUT RESET BUFFER)
R.S.B.
(READOUT SET BUFFER)
CR74
CR15
CR14
CR13
R1 1K
R9 2.2K
R2 1K
R12 2.2K
R10 2.2K
R11 2.2K
Q1
Q2
Q3
Q4
Q5
R13 33K
R14 33K
P3
SEE CHART
1
2
3
4
5
6
7
10
11
12
13
14
15
16
17
18
19
20
21
22
SEE CHART
Z READOUT TIMING PULSE
Z READOUT
S READOUT
Z BRIDGE
CR18
CR16
CR17
CR105
CR125
CR123
CR121
CR98
CR101
CR104
CR96
CR97
CR100
CR99
CR94
CR95
CR92
CR93
CR91
CR88
CR90
CR21
CR89
CR86
CR19
CR80
CR82
CR87
CR126
CR106
CR124
CR76
CR78
CR84
CR103
CR77
CR75
CR102
CR20
CR79
CR81
CR83
CR85
SEE CHART
SEE CHART
END OF SCAN
6 STAGE COUNTER DRIVE
START OF SCAN
S READOUT TIMING PULSE
+15.75 V
+3.75 V
+1.5 V
GND
-8.25 V
P4
R36 5.6K
R38 5.6K
R71 15K
R72 15K
P.B.
Q24 (PRINT BUFFER)

REVISIONS				
NO.	ADDED / DEL	DESCRIPTION	DATE	APPROVAL
1	ADD 1 DEL	CHART NOTE 3, CR17 WAS CR16	HGB 2-27-63	R W J 3-4-63

C. R. B.
(COMPUTE RESET BUFFER)

COUNTER STATE		PIN NO.	PULSE FUNCTION
000000	0	—	Z GATE
000001	1	22-P3	Z BRIDGE
000010	2	18-P3	S LOW RANGE
000011	3	17-P3	(POLARITY), S RANGE SELECT
001011	11	16-P3	(S MID RANGE)
010011	19	15-P3	(S HI RANGE), Z RANGE SELECT
011001	25	14-P3	S 20,000
011101	29	13-P3	S 40,000 (Z 20,000)
100001	33	12-P3	S 20,000X (Z 40,000)
100101	37	11-P3	S 10,000 (Z 20,000X)
101001	41	10-P3	S 2,000 (Z 10,000)
101011	43	7-P3	S 4,000 (Z 2,000)
101101	45	6-P3	S 2,000X (Z 4,000)
101111	47	5-P3	S 1,000 (Z 2,000X)
110001	49	4-P3	S 200 (Z 1,000)
110010	50	3-P3	S 400 (Z 200)
110011	51	2-P3	S 200X (Z 400)
110100	52	1-P3	S 100 (Z 200X)
110101	53	14-P4	S 20 (Z 100)
110110	54	15-P4	S 40 (Z 20)
110111	55	16-P4	S 20X (Z 40)
111000	56	17-P4	S 10 (Z 20X)
111001	57	18-P4	S 2 (Z 10)
111010	58	19-P4	S 4 (Z 2)
111011	59	20-P4	S 2X (Z 4)
111100	60	21-P4	S 1 (Z 2X)
111101	61	22-P4	(Z 1)
111101	61	20-P3	Z READOUT
111101	61	21-P3	S READOUT
111110	62	22-P3	Z BRIDGE
111111	63	12-P4	END OF SCAN

NOTES: 1. THE SYMBOL ( ) DENOTES FUNCTION PERFORMED WHEN COINCIDENT WITH DECISION PULSE.
2. Z & S READOUT FUNCTIONS ARE PERFORMED IN COINCIDENCE WITH PULSES FROM POLARITY-DECISION BOARD.
3. TO SHUT OFF Z BRIDGE PULSE AT END OF SCAN, CONNECT CATHODE OF CR17 TO PIN 5 OF P4.

10070-013
SHEET 2
/

4. ALL RESISTORS ARE ½ WATT, 10%.
3. ALL CAPACITORS ARE .022 UF, 200VDC.
2. ALL DIODES ARE NLS 5003-002.
1. ALL TRANSISTORS ARE TYPE 2N651.

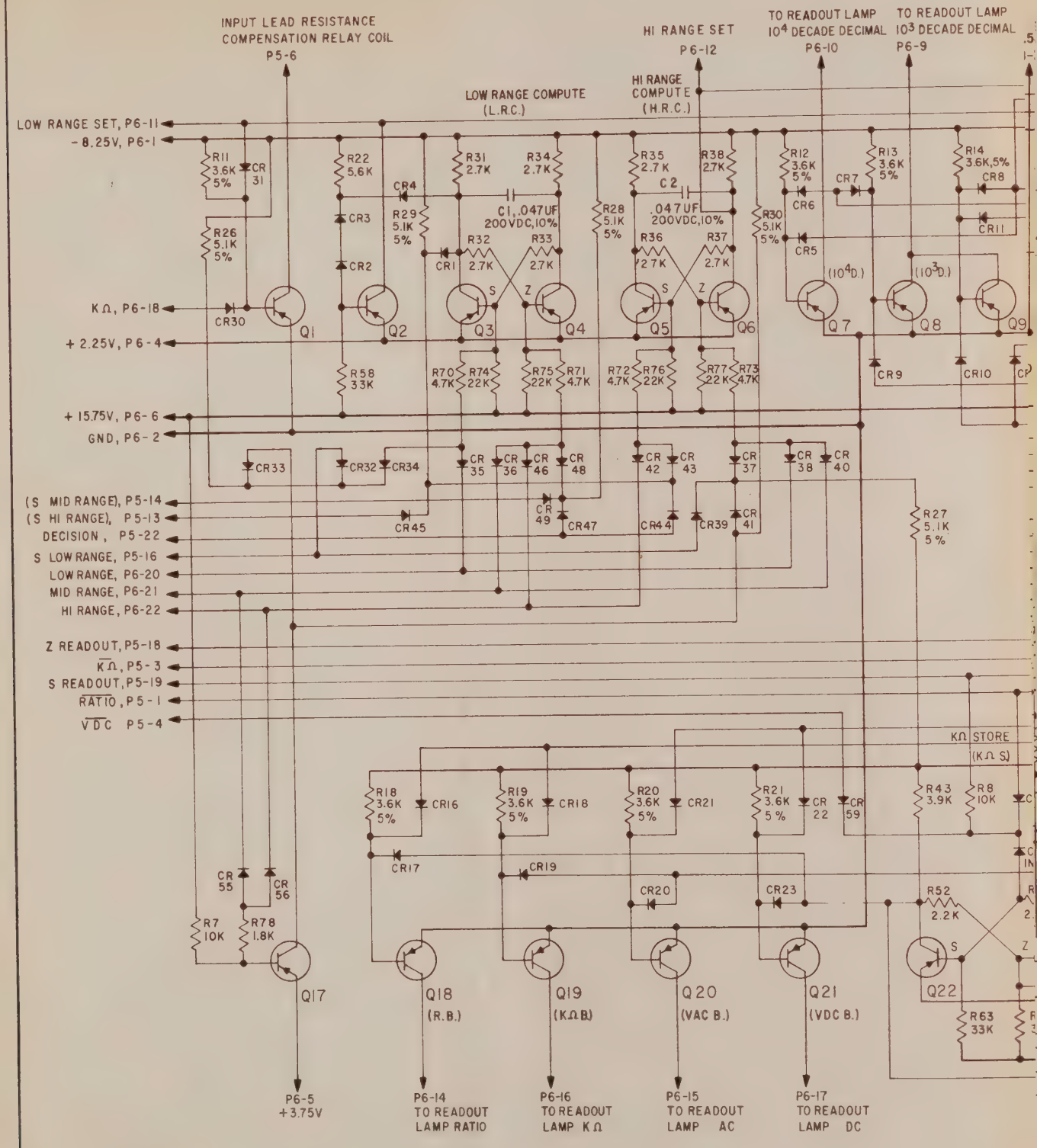
NOTES: UNLESS OTHERWISE SPECIFIED.

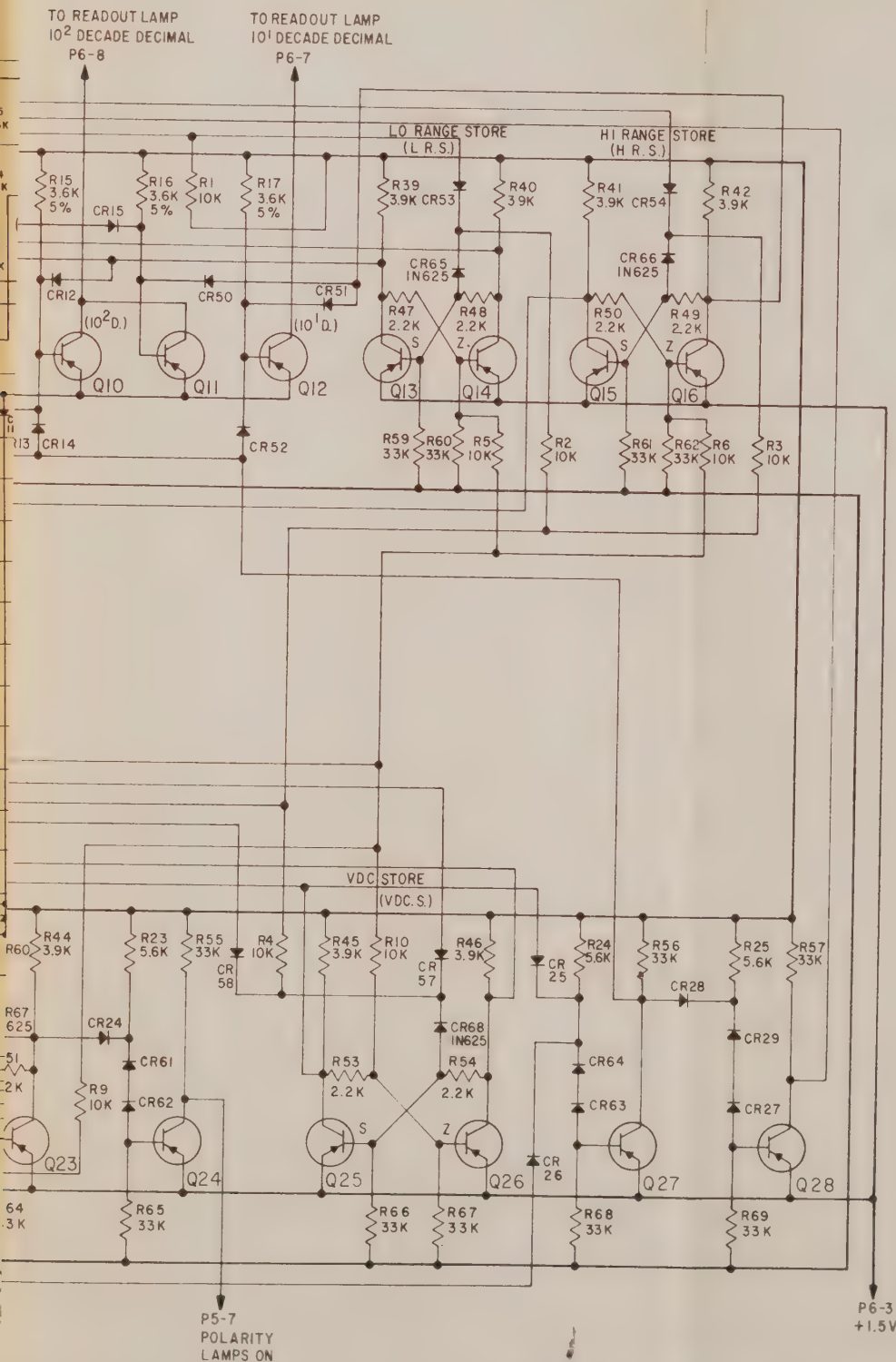
UNLESS OTHERWISE SPECIFIED	DRAWN BY H. BRINLEY	DATE 11-9-61	TITLE
	CHECKED BY		SCHEMATIC- 6 STAGE COUNTER
	APPROVED BY R. J. [illegible]	DATE 1-14-62	MODEL M25
MATERIAL	FINISH		SCALE

NON-LINEAR SYSTEMS INC.
DEL MAR, CALIFORNIA

10070-013

SHEET 2 OF


INPUT LEAD RESISTANCE COMPENSATION RELAY COIL
P5-6
LOW RANGE COMPUTE (L.R.C.)
HI RANGE SET
P6-12
HI RANGE COMPUTE (H.R.C.)
TO READOUT LAMP 10^4 DECADE DECIMAL
P6-10
TO READOUT LAMP 10^3 DECADE DECIMAL
P6-9
LOW RANGE SET, P6-11
-8.25V, P6-1
KΩ, P6-18
+2.25V, P6-4
+15.75V, P6-6
GND, P6-2
(S MID RANGE), P5-14
(S HI RANGE), P5-13
DECISION, P5-22
S LOW RANGE, P5-16
LOW RANGE, P6-20
MID RANGE, P6-21
HI RANGE, P6-22
Z READOUT, P5-18
KΩ, P5-3
S READOUT, P5-19
RATIO, P5-1
VDC P5-4
R11 3.6K 5%
CR 31
R22 5.6K
CR4
CR3
CR2
R29 5.1K 5%
R31 2.7K
R34 2.7K
C1, .047UF 200VDC,10%
R32 2.7K
R33 2.7K
CR1
R26 5.1K 5%
CR30
Q1
Q2
Q3
Q4
R58 33K
R70 4.7K
R74 22K
R75 22K
R71 4.7K
R28 5.1K 5%
R35 2.7K
R38 2.7K
C2 .047UF 200VDC,10%
R36 2.7K
R37 2.7K
Q5
Q6
R72 4.7K
R76 22K
R77 22K
R73 4.7K
R30 5.1K 5%
R12 3.6K 5%
CR6
CR5
Q7
R13 3.6K 5%
CR7
Q8
R14 3.6K,5%
CR8
CR11
Q9
CR9
CR10
CR33
CR32
CR34
CR 35
CR 36
CR 46
CR 48
CR 49
CR47
CR45
CR 42
CR 43
CR44
CR 37
CR39
CR 41
CR 38
CR 40
R27 5.1K 5%
CR 55
CR 56
R7 10K
R78 1.8K
Q17
R18 3.6K 5%
CR16
CR17
R19 3.6K 5%
CR18
CR19
R20 3.6K 5%
CR21
CR20
R21 3.6K 5%
CR 22
CR 59
CR23
Q18 (R.B.)
Q19 (KΩB)
Q20 (VAC B.)
Q21 (VDC B.)
KΩ STORE (KΩ S)
R43 3.9K
R8 10K
R52 2.2K
Q22
R63 33K
P6-5 +3.75V
P6-14 TO READOUT LAMP RATIO
P6-16 TO READOUT LAMP KΩ
P6-15 TO READOUT LAMP AC
P6-17 TO READOUT LAMP DC
3. ALL DIODES
2. ALL TRAN
1. ALL RESIS
NOTES: UNLESS OTH



RANGE/ FUNCTION		COLLECTOR LEVELS									
		Q4	Q6	Q14	Q16	Q7	Q8&9	Q10&11	Q12	Q1
RATIO	LO	–	+	–	+	GND	–	–	–	–
	MID	+	+	+	+	–	GND	–	–	–
	HI	+	–	+	–	–	–	GND	–	–
VDC & VAC	LO	–	+	–	+	–	GND	–	–	–
	MID	+	+	+	+	–	–	GND	–	–
	HI	+	–	+	–	–	–	–	GND	–
K Ω	LO	–	+	–	+	–	GND	–	–	GND
	MID	+	+	+	+	–	–	GND	–	–
	HI	+	–	+	–	–	–	–	GND	–

NOTE: Q1,7,8,9,10,11&12 WILL ONLY MEASURE (–) IF THEIR ASSOCIATED RELAY OR LAMP LOADS ARE CONNECTED.

FUNCTION	COLLECTOR LEVELS							
	Q23	Q26	Q18	Q19	Q20	Q21	Q27	Q28
RATIO	+	+	GND	–	–	–	+	–
K Ω	–	+	–	GND	–	–	–	+
VAC	–	–	–	–	GND	–	–	+
VDC	+	–	–	–	–	GND	–	+

NOTE: Q18,19,20&21 WILL ONLY MEASURE (–) IF THEIR ASSOCIATED LAMP LOADS ARE CONNECTED.

10070-015
SHEET 2

ARE NLS 5003-002.

SISTORS ARE TYPE 2N651.

TORS ARE $\frac{1}{2}$ WATT, 10%.

ERWISE SPECIFIED.

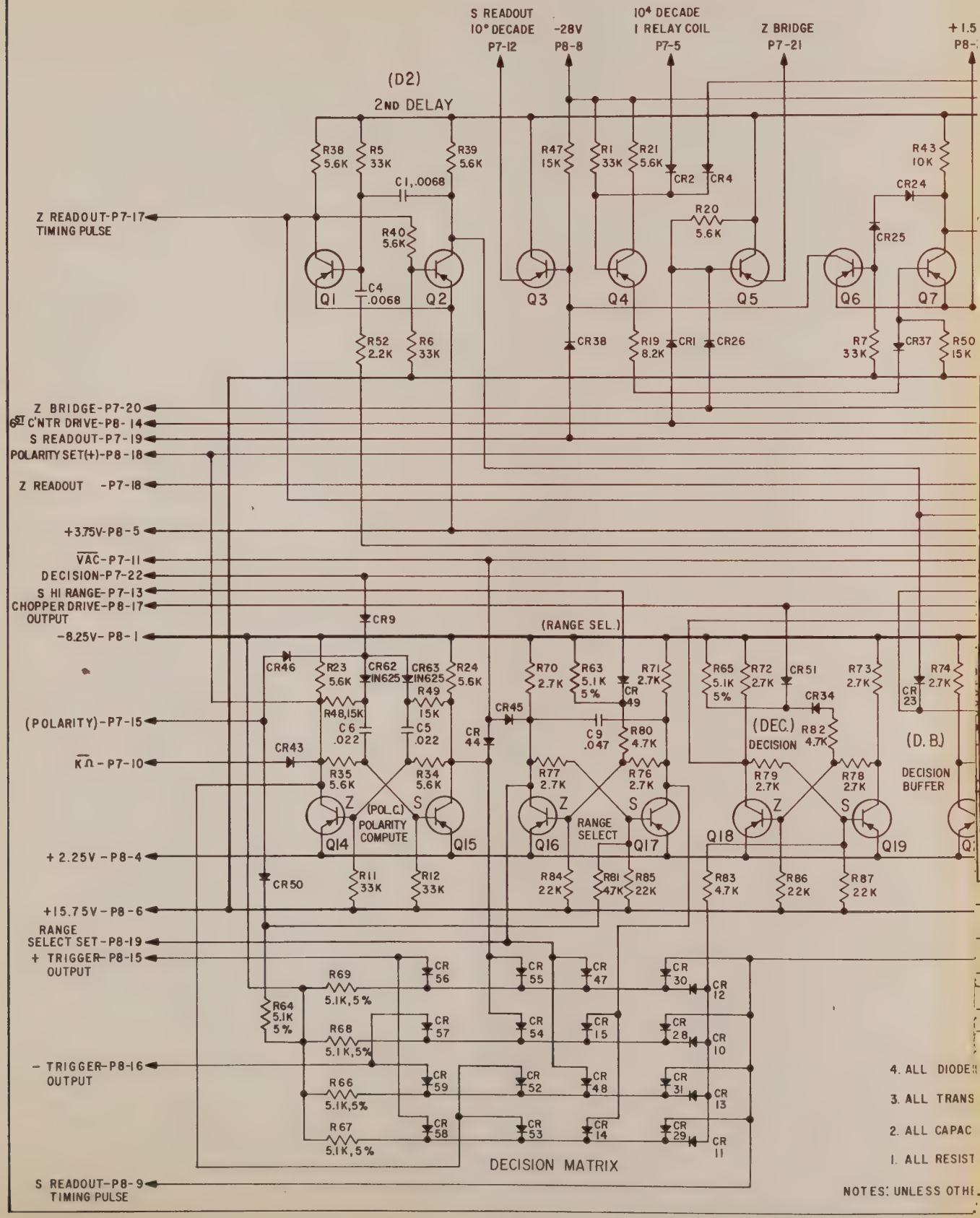
UNLESS OTHERWISE SPECIFIED	DRAWN BY	DATE
DIMENSIONS ARE IN INCHES	H. BRINLEY	12-12-61
TOLERANCES ON	CHECKED BY	DATE
FRACTION ± DECIMAL ± ANGLES ±	APPROVED BY R. Johnson	DATE 1-14-62
MATERIAL	FINISH	

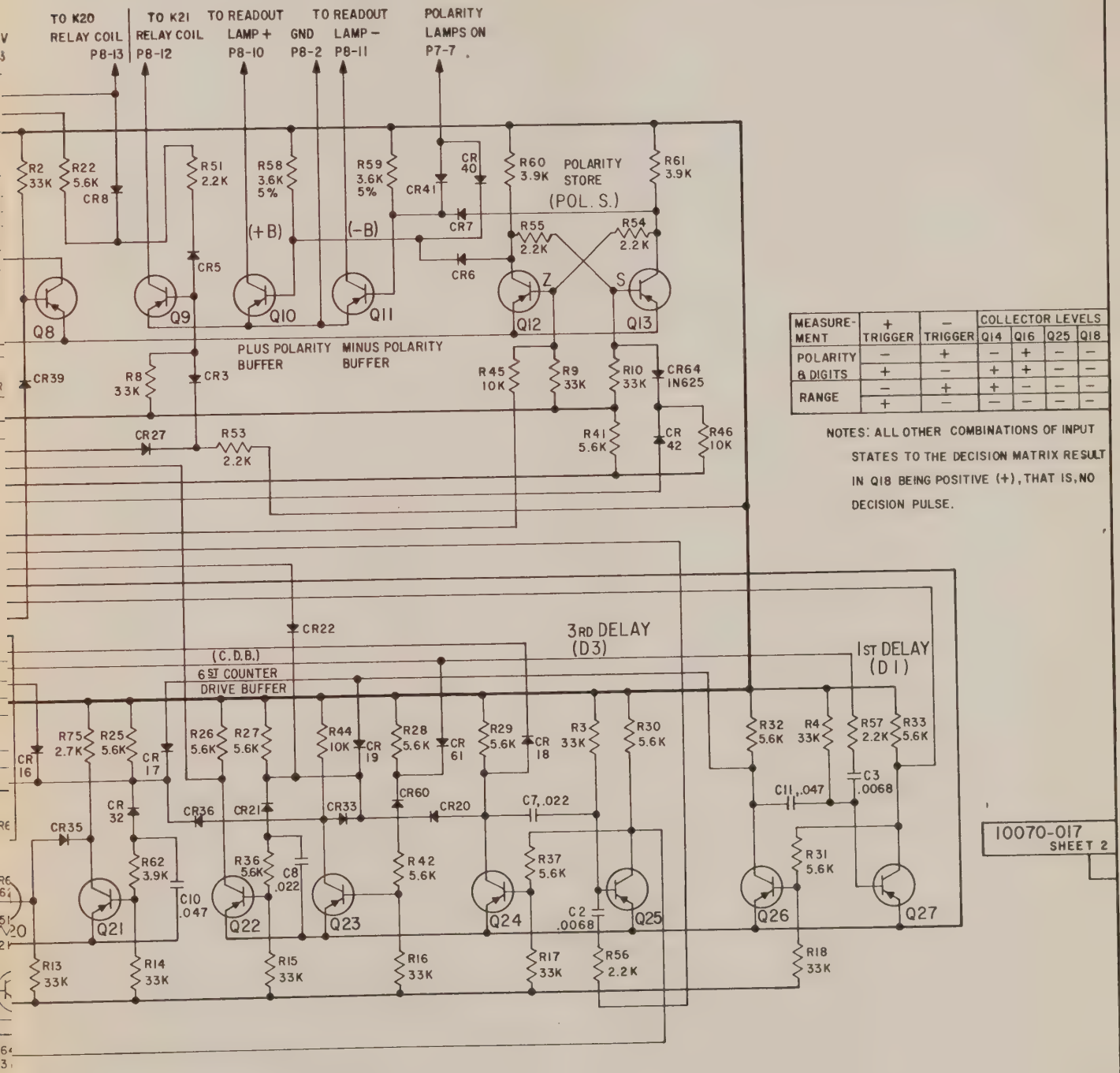
TITLE
SCHEMATIC - RANGE - FUNCTION
MODEL M25

NON-LINEAR SYSTEMS INC
DEL MAR AIRPORT
DEL MAR CALIFORNIA

DRAWING NUMBER
10070-015

SCALE | WT | SHEET 2 OF


S READOUT 10° DECADE P7-12
-28V P8-8
10⁴ DECADE I RELAY COIL P7-5
Z BRIDGE P7-21
(D2)
2ND DELAY
Z READOUT-P7-17 TIMING PULSE
Z BRIDGE-P7-20
6ST C'NTR DRIVE-P8-14
S READOUT-P7-19
POLARITY SET(+)-P8-18
Z READOUT -P7-18
+3.75V-P8-5
VAC-P7-11
DECISION-P7-22
S HI RANGE-P7-13
CHOPPER DRIVE-P8-17 OUTPUT
-8.25V-P8-1
(POLARITY)-P7-15
KΩ-P7-10
+2.25V-P8-4
+15.75V-P8-6
RANGE SELECT SET-P8-19
+ TRIGGER-P8-15 OUTPUT
- TRIGGER-P8-16 OUTPUT
S READOUT-P8-9 TIMING PULSE
(RANGE SEL.)
(POL.C.) POLARITY COMPUTE
RANGE SELECT
(DEC.) DECISION
(D.B.) DECISION BUFFER
DECISION MATRIX
NOTES: UNLESS OTHE
1. ALL RESIST
2. ALL CAPAC
3. ALL TRANS
4. ALL DIODE



MEASUREMENT	+ TRIGGER	− TRIGGER	COLLECTOR LEVELS Q14	Q16	Q25	Q18
POLARITY & DIGITS	−	+	−	+	−	−
	+	−	+	+	−	−
RANGE	−	+	+	−	−	−
	+	−	−	−	−	−

NOTES: ALL OTHER COMBINATIONS OF INPUT STATES TO THE DECISION MATRIX RESULT IN Q18 BEING POSITIVE (+), THAT IS, NO DECISION PULSE.

10070-017 SHEET 2

S ARE NLS 5003-002.

ANSISTORS ARE TYPE 2N651.

SISTORS ARE IN MICROFARADS, 10%, 200VDC.

TORS ARE $\frac{1}{2}$ WATT, 10%.

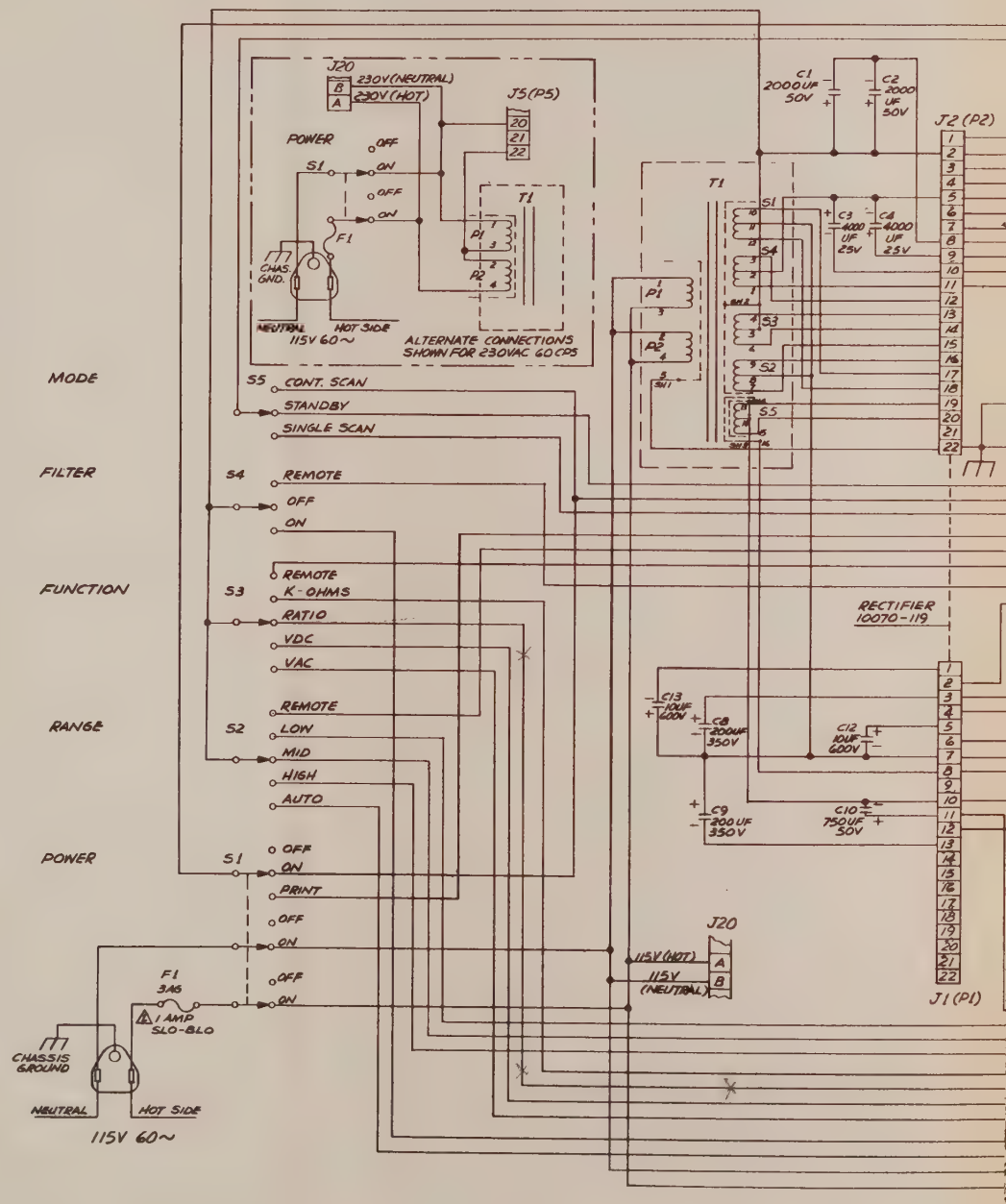
RWISE SPECIFIED.

UNLESS OTHERWISE SPECIFIED	DRAWN BY H. BRINLEY	DATE 12-12-61	TITLE SCHEMATIC - POLARITY-DECISION MODEL M25
DIMENSIONS ARE IN INCHES	CHECKED BY	DATE	
TOLERANCES ON FRACTIONS ± DECIMAL ± ANGLES ±	APPROVED BY R. Jonason	DATE 1-14-62	
MATERIAL	FINISH		SCALE WT

NON-LINEAR SYSTEMS INC. DEL MAR AIRPORT DEL MAR CALIFORNIA

DRAWING NUMBER 10070-017

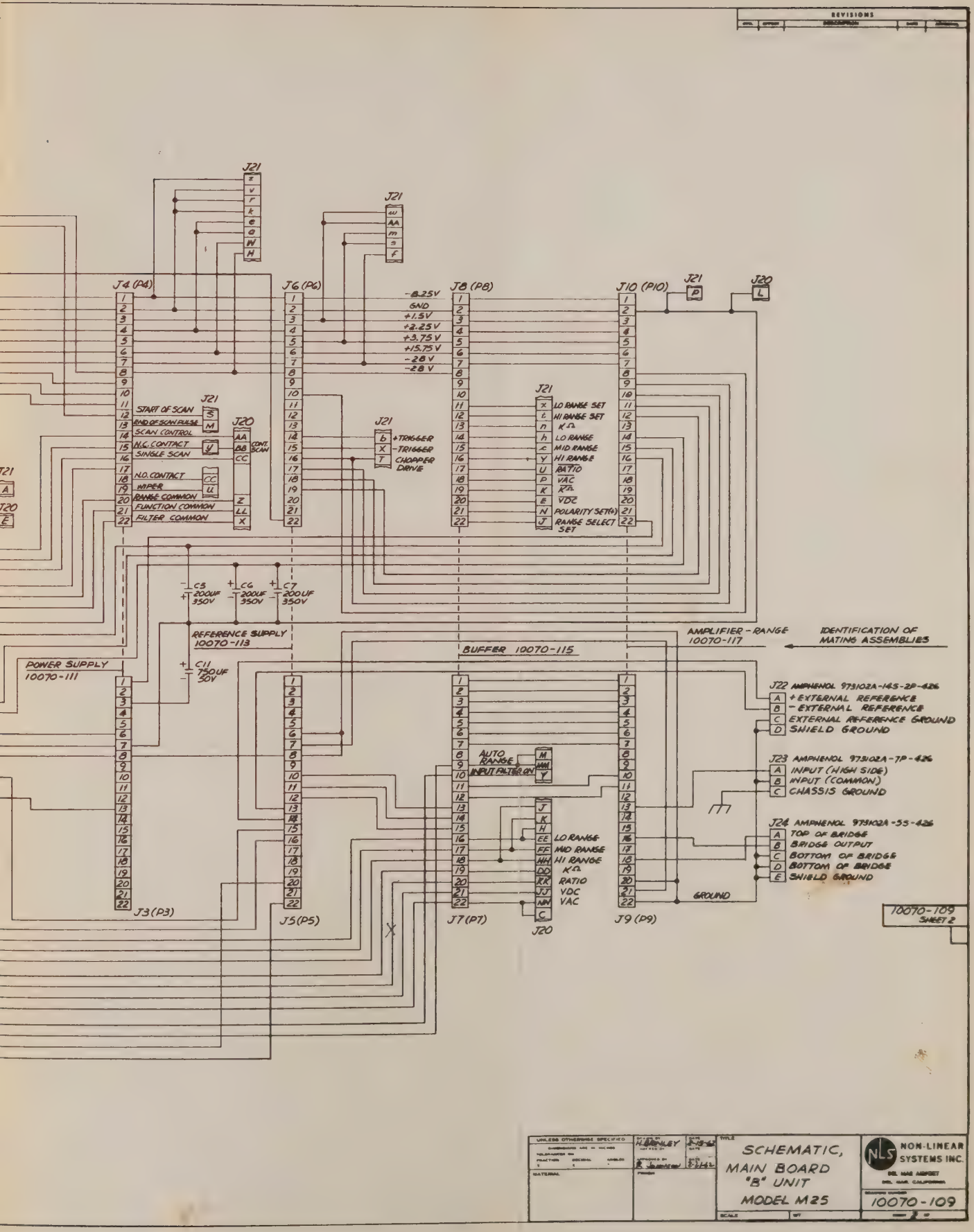
SHEET 2 OF

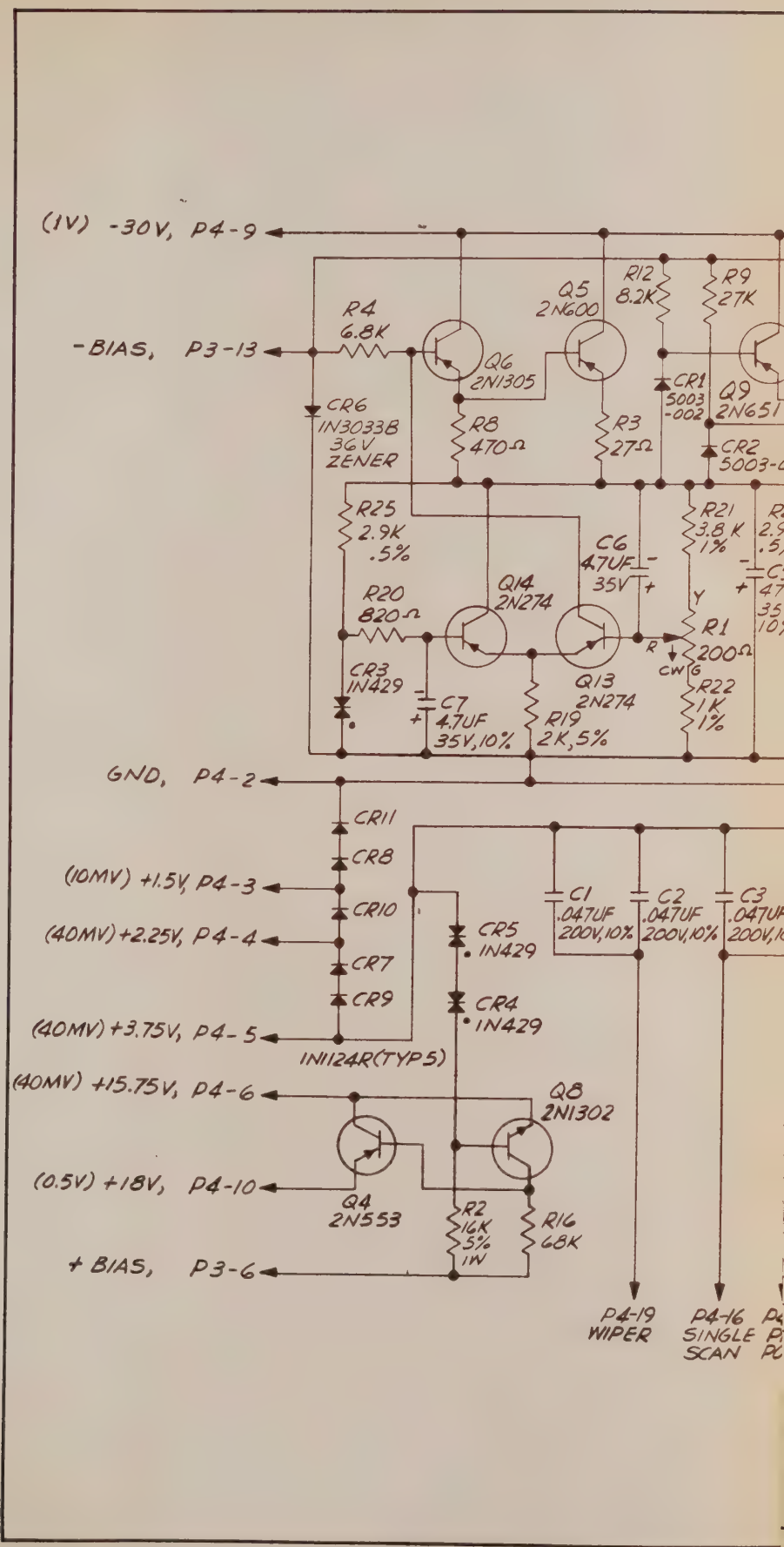


2. CAUTION: HIGH VOLTAGE PRESENT ON MAIN BOARD.

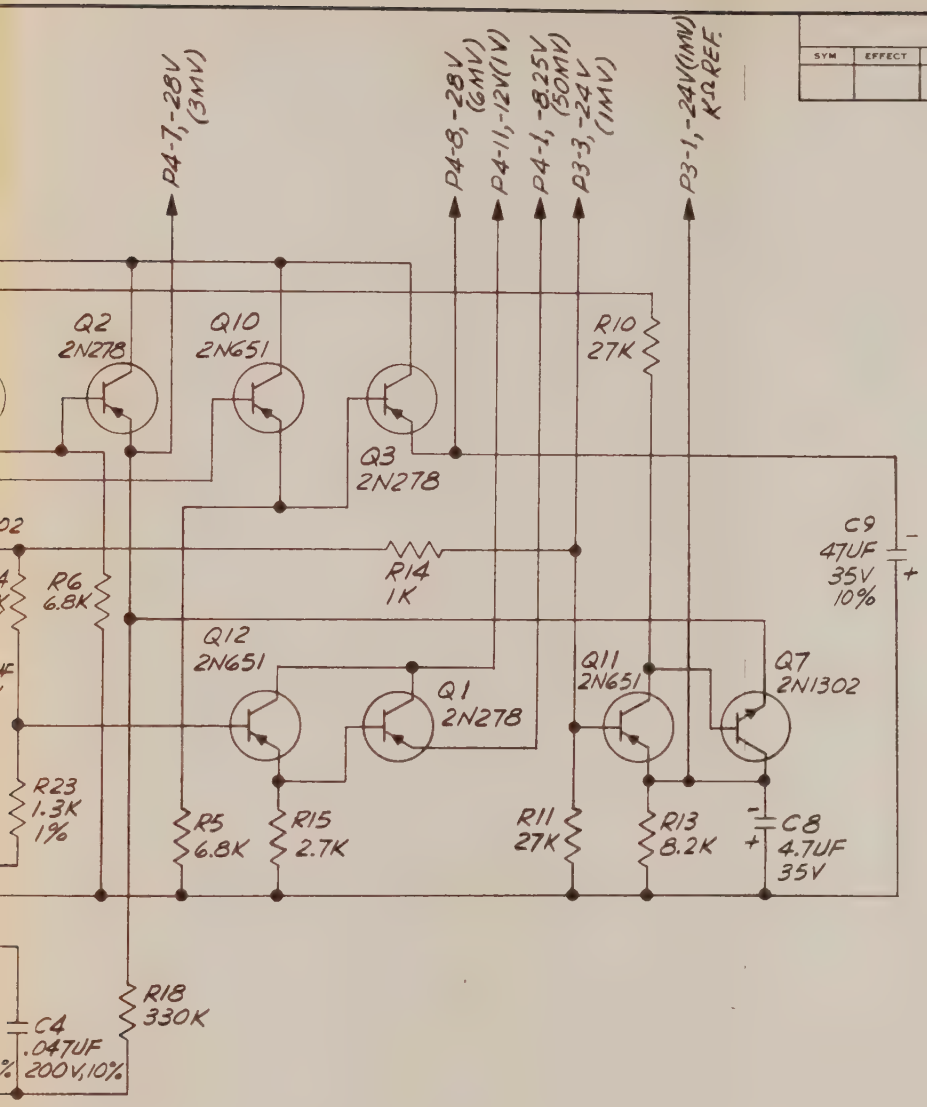
⚠ WHEN OPERATING M2S WITH 125E AC/DC CONVERTER CHANGE F1 FROM 1 AMP SLO-BLO TO 2 AMP SLO-BLO

NOTES:


REVISIONS
J21
J4 (P4)
J6 (P6)
J8 (P8)
J10 (P10)
J20
START OF SCAN
END OF SCAN PULSE
SCAN CONTROL
N.C. CONTACT
SINGLE SCAN
N.O. CONTACT
WIPER
RANGE COMMON
FUNCTION COMMON
FILTER COMMON
CONT. SCAN
-8.25V
GND
+1.5V
+2.25V
+3.75V
+15.75V
-28V
-28V
+TRIGGER
-TRIGGER
CHOPPER DRIVE
LO RANGE SET
HI RANGE SET
KΩ
LO RANGE
MID RANGE
HI RANGE
RATIO
VAC
KΩ
VDC
POLARITY SET(+)
RANGE SELECT SET
C8 200UF 350V
C6 200UF 350V
C7 200UF 350V
REFERENCE SUPPLY 10070-113
C11 750UF 50V
POWER SUPPLY 10070-111
BUFFER 10070-115
AMPLIFIER - RANGE 10070-117
IDENTIFICATION OF MATING ASSEMBLIES
J22 AMPHENOL 97310ZA-14S-2P-426
+EXTERNAL REFERENCE
-EXTERNAL REFERENCE
EXTERNAL REFERENCE GROUND
SHIELD GROUND
J23 AMPHENOL 97310ZA-7P-426
INPUT (HIGH SIDE)
INPUT (COMMON)
CHASSIS GROUND
J24 AMPHENOL 97310ZA-5S-426
TOP OF BRIDGE
BRIDGE OUTPUT
BOTTOM OF BRIDGE
BOTTOM OF BRIDGE
SHIELD GROUND
AUTO RANGE
INPUT FILTER ON
LO RANGE
MID RANGE
HI RANGE
KΩ
RATIO
VDC
VAC
GROUND
J3 (P3)
J5 (P5)
J7 (P7)
J9 (P9)
10070-109 SHEET 2
UNLESS OTHERWISE SPECIFIED
MATERIAL
H. BARNLEY
SCHEMATIC, MAIN BOARD "B" UNIT MODEL M25
NON-LINEAR SYSTEMS INC.
10070-109


(1V) -30V, P4-9
-BIAS, P3-13
R4 6.8K
Q6 2N1305
Q5 2N600
R12 8.2K
R9 27K
CR1 5003-002
Q9 2N651
CR6 IN3033B 36V ZENER
R8 470Ω
R3 27Ω
CR2 5003-
R25 2.9K .5%
C6 4.7UF 35V
R21 3.8K 1%
Q14 2N274
R20 820Ω
Q13 2N274
R1 200Ω
CW
R22 1K 1%
CR3 IN429
C7 4.7UF 35V,10%
R19 2K,5%
GND, P4-2
CR11
CR8
(10MV) +1.5V, P4-3
CR10
(40MV) +2.25V, P4-4
CR7
CR9
(40MV) +3.75V, P4-5
IN1124R(TYP5)
CR5 IN429
CR4 IN429
C1 .047UF 200V,10%
C2 .047UF 200V,10%
C3 .047UF
(40MV) +15.75V, P4-6
Q8 2N1302
(0.5V) +18V, P4-10
Q4 2N553
R2 16K 5% 1W
R16 68K
+BIAS, P3-6
P4-19 WIPER
P4-16 SINGLE SCAN

REVISIONS				
SYM	EFFECT	DESCRIPTION	DATE	APPROVAL



10070-111
SHEET 2

3. ADJUST R1 FOR 28V DROP ACROSS C5.

2. TYPICAL PEAK-TO-PEAK RIPPLE VOLTAGE MEASUREMENTS ARE SHOWN IN PARENTHESES. ALL VOLTAGES ARE MEASURED WITH RESPECT TO PIN 2 OF P4.

1. ALL RESISTORS ARE $\frac{1}{2}$ WATT, 10%.

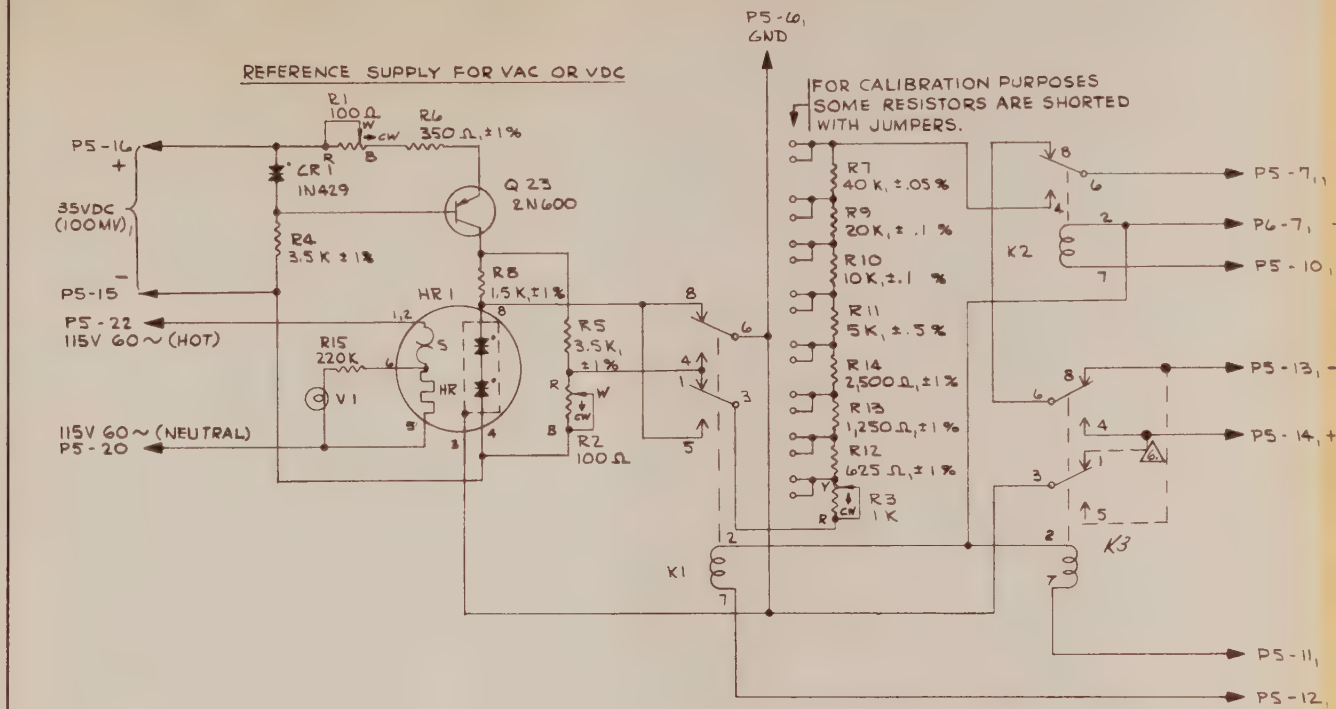
NOTES: UNLESS OTHERWISE SPECIFIED

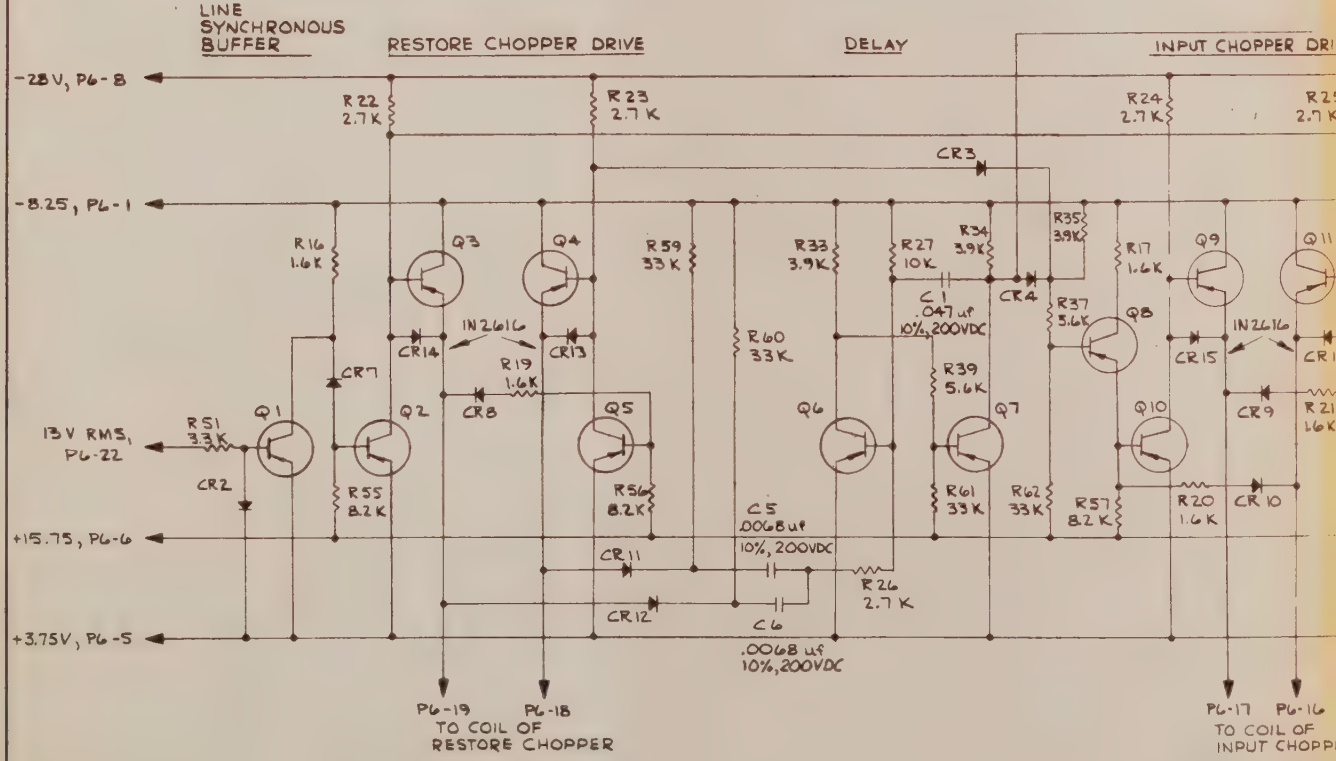
NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTION ± DECIMAL ± ANGLES ± MATERIAL	DRAWN BY H. BRINLEY DATE 1-31-62 CHECKED BY DATE APPROVED BY P. JOHNSON DATE 2-21-62 FINISH	TITLE SCHEMATIC - POWER SUPPLY MODEL M25 SCALE WT.

NLS NON-LINEAR SYSTEMS INC.
DEL MAR AIRPORT
DEL MAR, CALIFORNIA

DRAWING NUMBER 10070-111
SHEET 2 OF 2





WHEN USING A FLO

5. ALL RELAYS ARE

4. ALL RELAY COI THE CONDITIONS

3. ALL DIODES

2. ALL TRANSIST

1. ALL RESISTORS

NOTES: UNLESS OTHERV

REVISIONS				
SYM	EFFECT	DESCRIPTION	DATE	APPROVAL

EF.

V

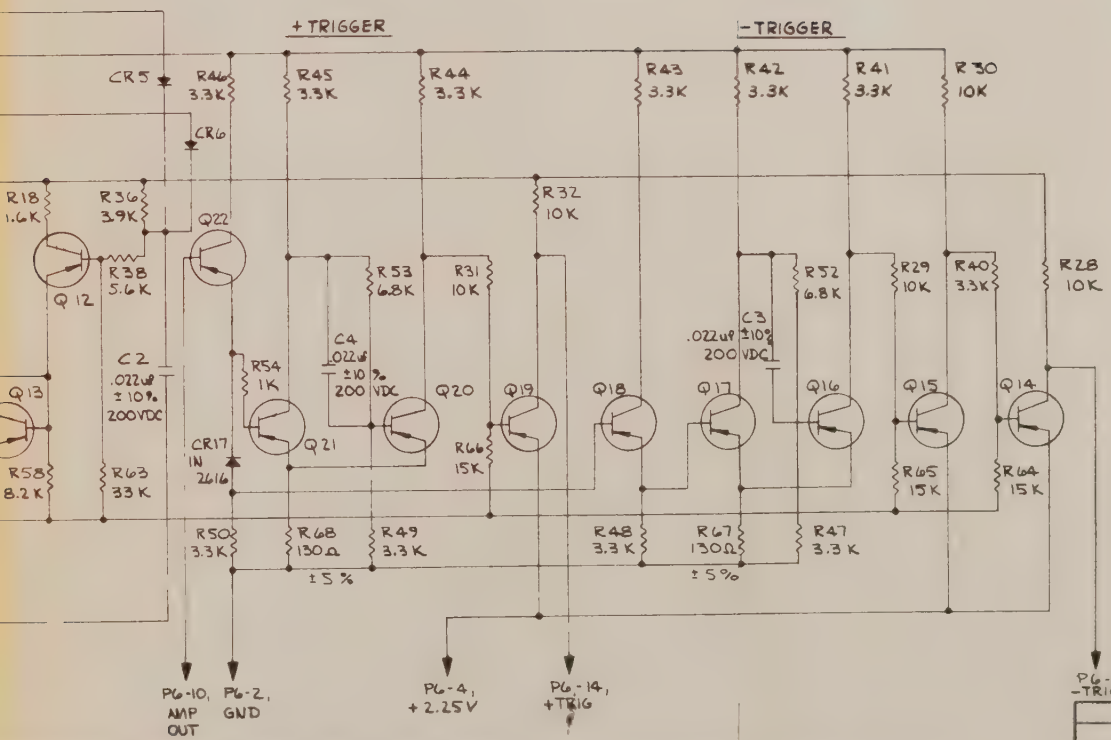
OR VDC RELAY COIL

T. REF.

T. REF.

+ RATIO POLARITY RELAY COIL

+VDC POLARITY RELAY COIL



10070-113
SHT. 2

TING EXTERNAL REFERENCE, JUMPER 5 TO 8 & 1 TO 4 ON K3.
SHOWN IN NORMALLY CLOSED (DE-ENERGIZED) POSITION.
CONTACTS ARE IDENTIFIED BY
OR WHICH THE CONTACTS ARE GROUNDED.
S 5003-002.
R ARE TYPE 2N651.
ARE ½ WATT, 10%
SE SPECIFIED.

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED	DRAWN BY	DATE
DIMENSIONS ARE IN INCHES	G. WALKER	1-31-62
TOLERANCES ON FRACTION ± DECIMAL ± ANGLES ±	CHECKED BY	DATE
MATERIAL	APPROVED BY R. JOHNSON	DATE 2-27-62
	FINISH	

TITLE: SCHEMATIC - REFERENCE SUPPLY

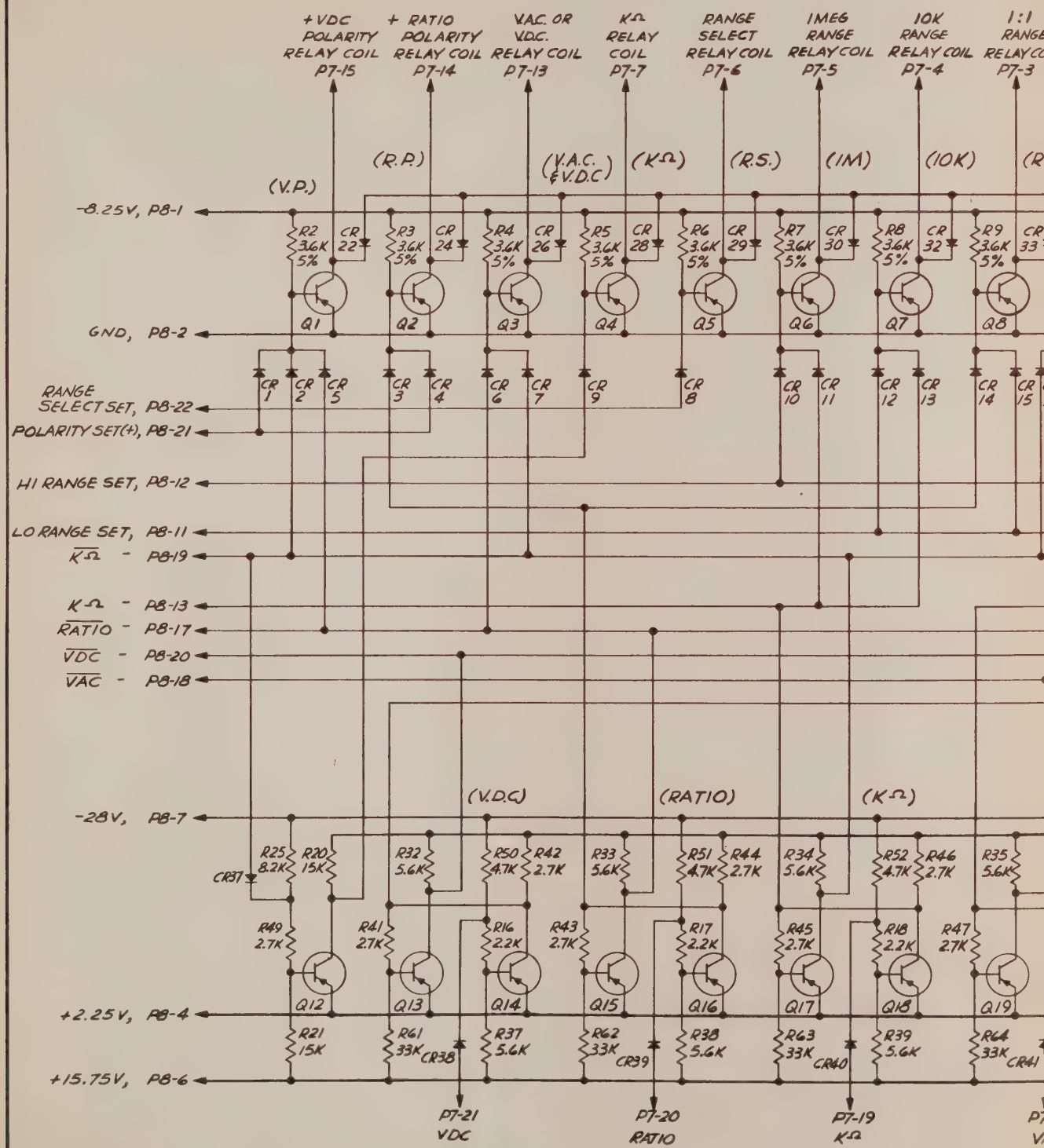
MODEL M25

SCALE | WT.

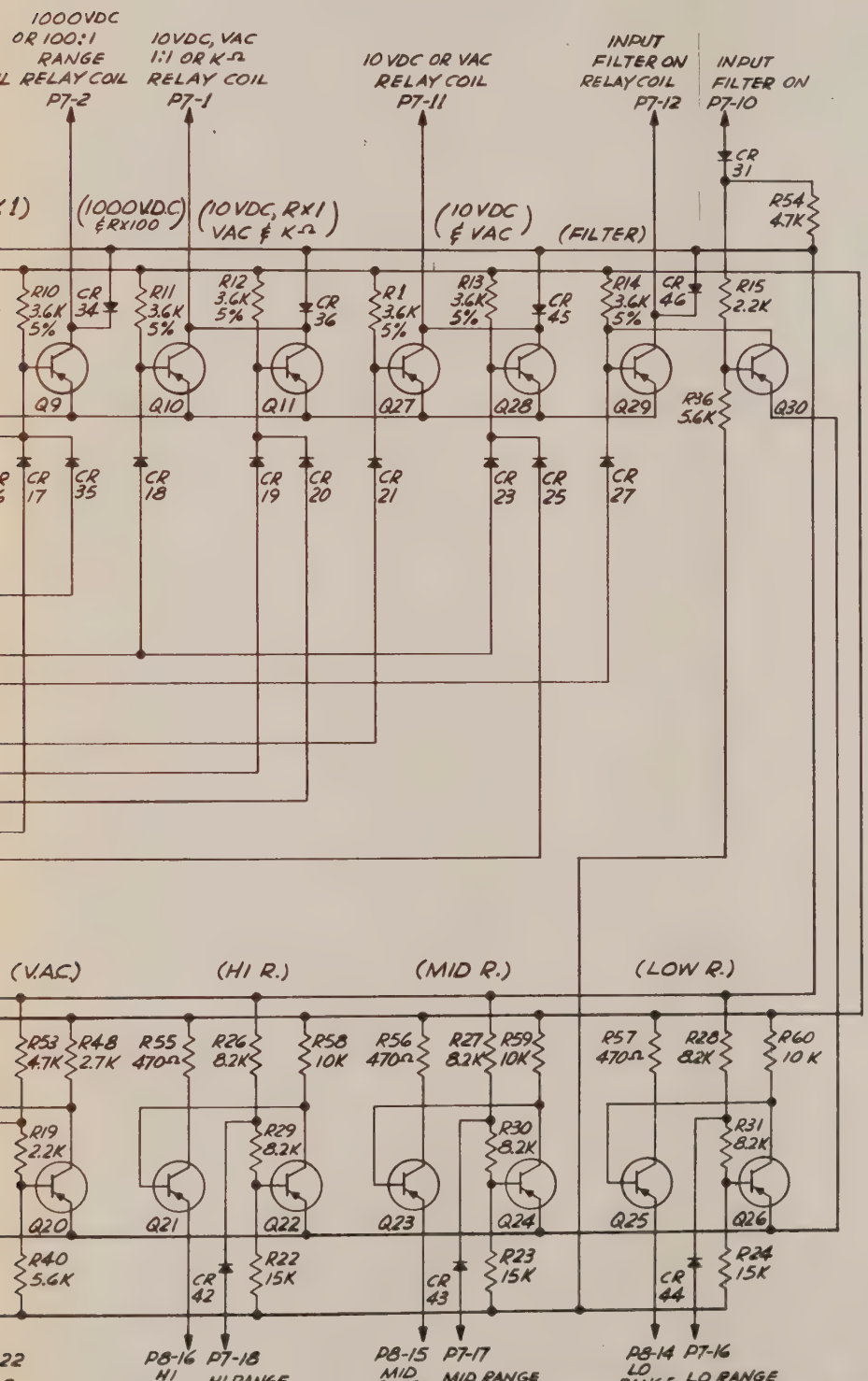
NLS NON-LINEAR SYSTEMS INC.
DEL MAR AIRPORT
DEL MAR, CALIFORNIA

DRAWING NUMBER 10070-113

SHEET 2 OF


+VDC POLARITY RELAY COIL P7-15
+ RATIO POLARITY RELAY COIL P7-14
VAC. OR VDC. RELAY COIL P7-13
KΩ RELAY COIL P7-7
RANGE SELECT RELAY COIL P7-6
1MEG RANGE RELAY COIL P7-5
10K RANGE RELAY COIL P7-4
(V.P.)
(R.P.)
(V.A.C. & V.D.C)
(KΩ)
(R.S.)
(1M)
(10K)
-8.25V, P8-1
GND, P8-2
R2 3.6K 5%
R3 3.6K 5%
R4 3.6K 5%
R5 3.6K 5%
R6 3.6K 5%
R7 3.6K 5%
R8 3.6K 5%
R9 3.6K 5%
CR 22
CR 24
CR 26
CR 28
CR 29
CR 30
CR 32
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
CR 1
CR 2
CR 5
CR 3
CR 4
CR 6
CR 7
CR 9
CR 8
CR 10
CR 11
CR 12
CR 13
CR 14
RANGE SELECT SET, P8-22
POLARITY SET(+), P8-21
HI RANGE SET, P8-12
LO RANGE SET, P8-11
KΩ - P8-19
KΩ - P8-13
RATIO - P8-17
VDC - P8-20
VAC - P8-18
(V.D.C)
(RATIO)
(KΩ)
-28V, P8-7
+2.25V, P8-4
+15.75V, P8-6
CR37
R25 8.2K
R20 15K
R32 5.6K
R50 4.7K
R42 2.7K
R33 5.6K
R51 4.7K
R44 2.7K
R34 5.6K
R52 4.7K
R46 2.7K
R35 5.6K
R49 2.7K
R41 2.7K
R16 2.2K
R43 2.7K
R17 2.2K
R45 2.7K
R18 2.2K
R47 2.7K
Q12
Q13
Q14
Q15
Q16
Q17
Q18
Q19
R21 15K
R61 33K
CR38
R37 5.6K
R62 33K
CR39
R38 5.6K
R63 33K
CR40
R39 5.6K
R64 33K
CR41
P7-21 VDC
P7-20 RATIO
P7-19 KΩ

REVISIONS				
SYM.	EFFECT.	DESCRIPTION	DATE	APPROVAL



6. ALL SWITCH OR REMOTE CONTROL CONTACTS (P7-10, 16 THRU 22) ARE IDENTIFIED BY THE CONDITIONS FOR WHICH THE CONTACTS ARE GROUNDED OR CLOSED. FOR ALL OTHER CONDITIONS THE CONTACTS ARE NEGATIVE (-) OR OPEN.

5. ALL LOGIC CONTACTS (P8-1 THRU 22) ARE IDENTIFIED BY THE CONDITIONS FOR WHICH THE CONTACTS ARE NEGATIVE (-). FOR ALL OTHER CONDITIONS THE CONTACTS ARE POSITIVE (+).

10070-115 SHEET 2

4. ALL RELAY COIL CONTACTS (P7-1 THRU 7 & P7-11 THRU 15) ARE IDENTIFIED BY THE CONDITION (S) FOR WHICH THE CONTACTS ARE GROUNDED. THUS P7-5 IS GROUNDED ONLY IF THE METER IS IN THE 1 MEG RANGE.

3. ALL RESISTORS ARE $\frac{1}{2}$ WATT, 10%.

2. ALL DIODES ARE NLS 5003-002.

1. ALL TRANSISTORS ARE TYPE 2N631.

NOTES: UNLESS OTHERWISE SPECIFIED.

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED	DRAWN BY	DATE
DIMENSIONS ARE IN INCHES	H. BRINLEY	2-28-62
TOLERANCES ON FRACTION ± DECIMAL ± ANGLES ±	CHECKED BY	DATE
MATERIAL	APPROVED BY R. JOHNSON	DATE 2-21-62
	FINISH	

TITLE

SCHEMATIC, BUFFER

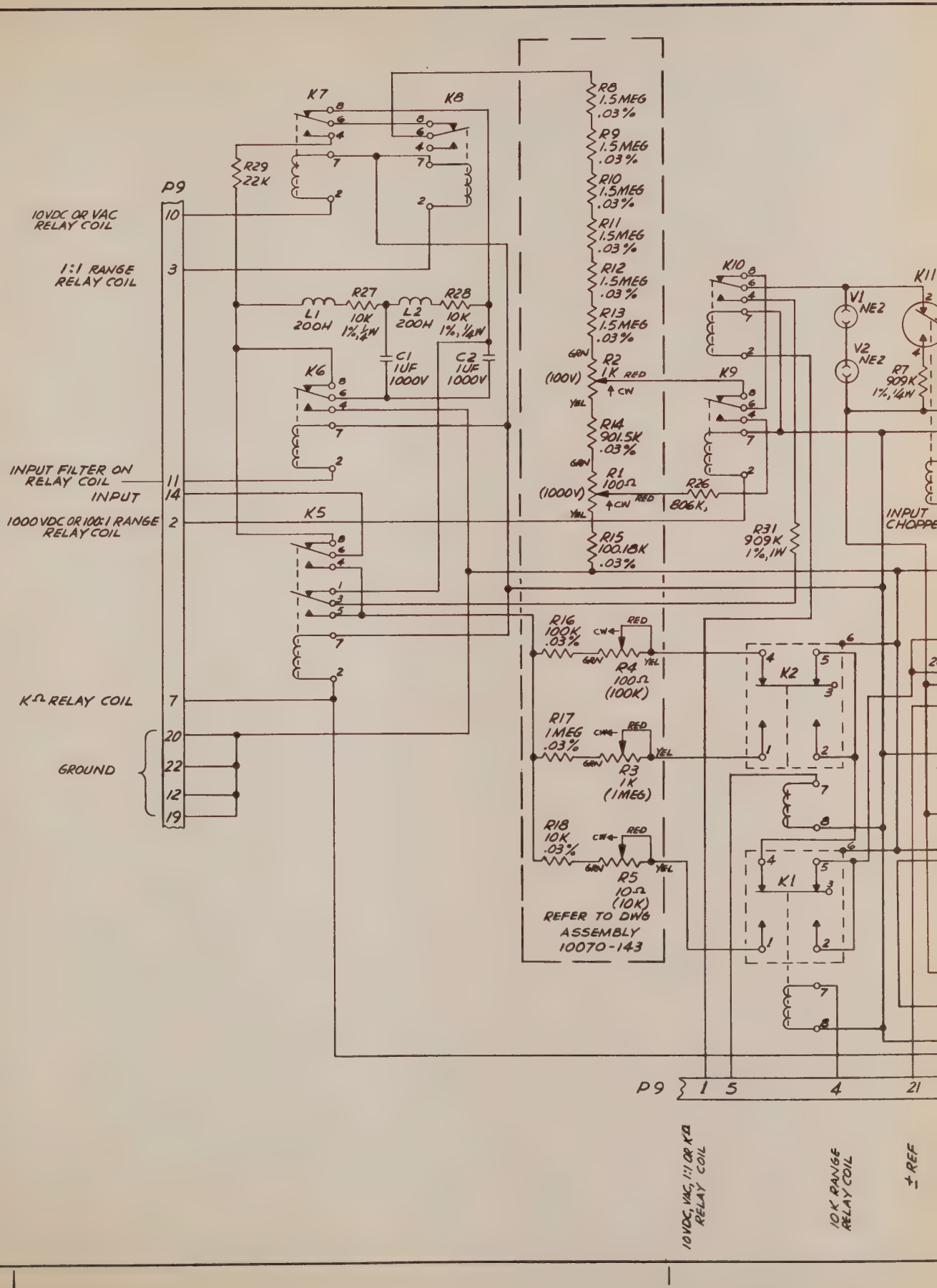
MODEL M25

SCALE WT.

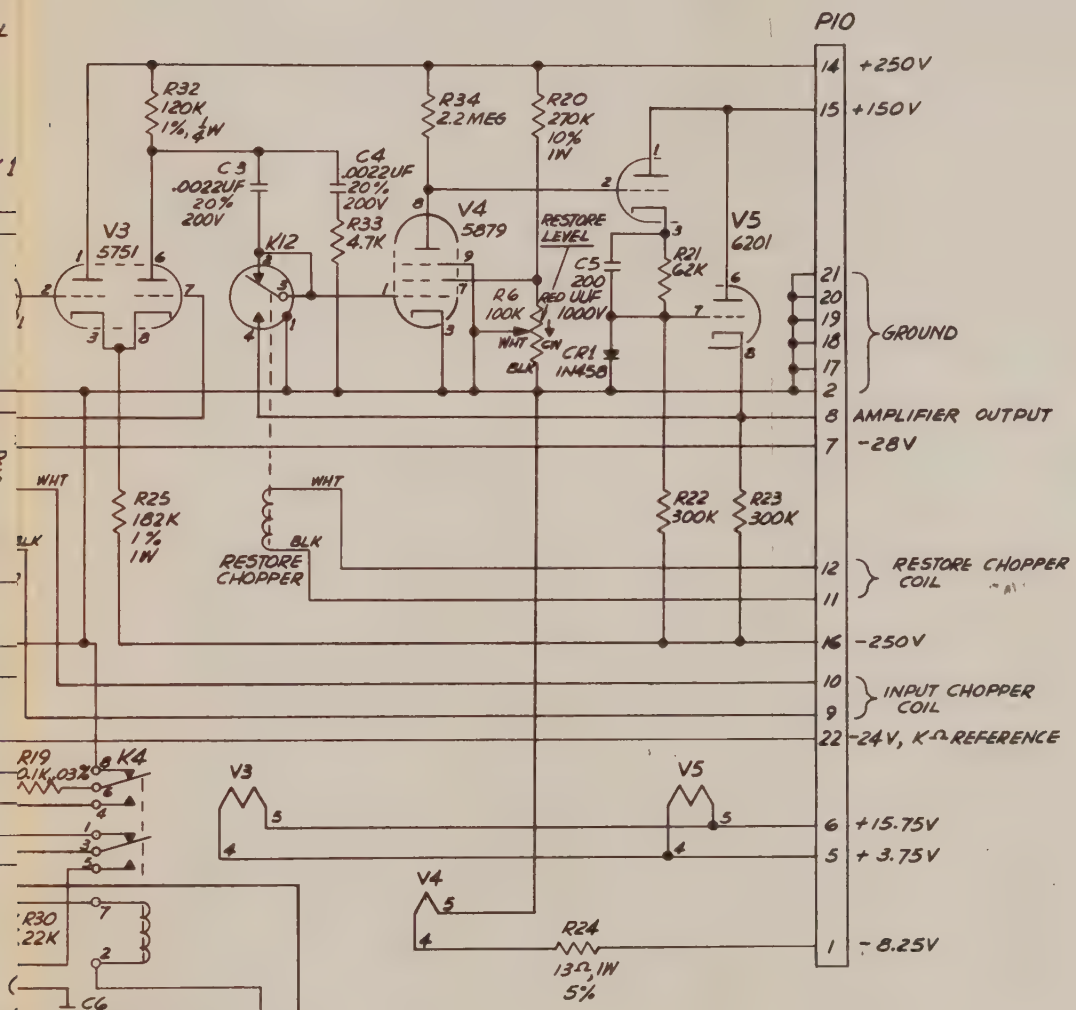
NON-LINEAR SYSTEMS INC.
DEL MAR AIRPORT
DEL MAR, CALIFORNIA

DRAWING NUMBER 10070-115

SHEET 2 OF 2


P9
10VDC OR VAC RELAY COIL
1:1 RANGE RELAY COIL
INPUT FILTER ON RELAY COIL
INPUT
1000 VDC OR 100:1 RANGE RELAY COIL
KΩ RELAY COIL
GROUND
10
3
11
14
2
7
20
22
12
19
K7
K8
K6
K5
K10
K9
K11
K2
K1
R29 22K
R27 10K 1%,1/4W
R28 10K 1%,1/4W
L1 200H
L2 200H
C1 1UF 1000V
C2 1UF 1000V
R8 1.5MEG .03%
R9 1.5MEG .03%
R10 1.5MEG .03%
R11 1.5MEG .03%
R12 1.5MEG .03%
R13 1.5MEG .03%
R2 1K
(100V)
R14 901.5K .03%
R1 100Ω
(1000V)
R26 806K,
R15 100.18K .03%
R31 909K 1%,1W
R16 100K .03%
R4 100Ω (100K)
R17 1MEG .03%
R3 1K (1MEG)
R18 10K .03%
R5 10Ω (10K)
REFER TO DWG ASSEMBLY 10070-143
V1 NE2
V2 NE2
R7 909K 1%,1/4W
INPUT CHOPPE
P9 1 5 4 21
10 VDC, VAC, 1:1 OR KΩ RELAY COIL
10 K RANGE RELAY COIL
± REF

REVISIONS				
SYM.	EFFECT.	DESCRIPTION	DATE	APPROVAL



10070-117
SHEET 2

4. CAUTION: HIGH VOLTAGE PRESENT ON AMPLIFIER-RANGE BOARD.

3. DO NOT UNPLUG AMPLIFIER-RANGE BOARD FROM MAIN BOARD WITH POWER ON, OR ELSE THE FUSE WILL BLOW.

2. ALL RELAYS ARE SHOWN IN NORMALLY CLOSED (DE-ENERGIZED) POSITION.

1. ALL RESISTORS ARE ½ WATT, 10%.

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED	DRAWN BY	DATE
DIMENSIONS ARE IN INCHES	V. BENILEY	2-7-62
TOLERANCES ON FRACTION ± DECIMAL ± ANGLES ±	CHECKED BY	DATE
	APPROVED BY R. Johnson	DATE 2-21-62
MATERIAL	FINISH	

TITLE: SCHEMATIC, AMPLIFIER-RANGE

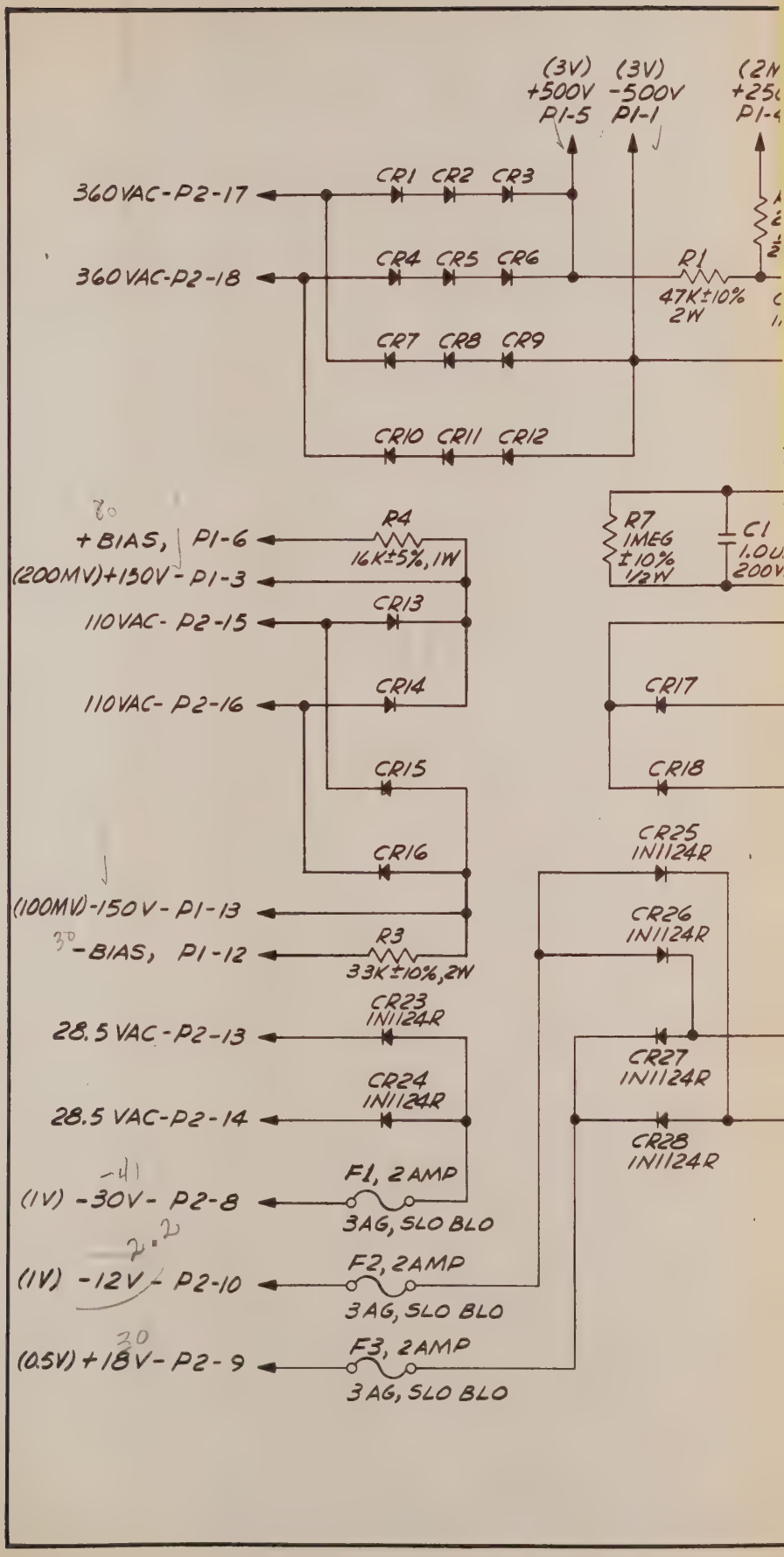
MODEL M25

SCALE | WT.

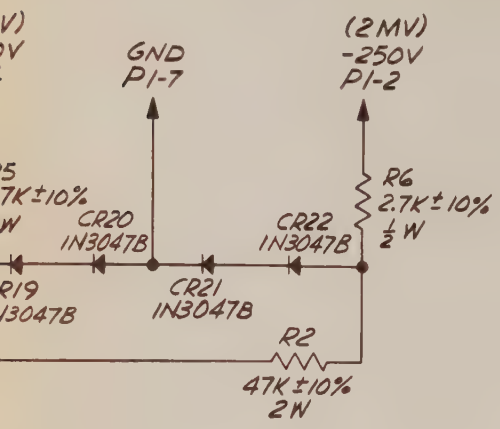
NLS NON-LINEAR SYSTEMS INC.
DEL MAR AIRPORT
DEL MAR, CALIFORNIA

DRAWING NUMBER 10070-117

SHEET 2 OF 2


(3V) +500V P1-5
(3V) -500V P1-1
360VAC-P2-17
360VAC-P2-18
CR1 CR2 CR3
CR4 CR5 CR6
CR7 CR8 CR9
CR10 CR11 CR12
R1 47K±10% 2W
+BIAS, P1-6
(200MV)+150V- P1-3
110VAC- P2-15
110VAC- P2-16
R4 16K±5%, 1W
CR13
CR14
CR15
CR16
(100MV)-150V- P1-13
-BIAS, P1-12
R3 33K±10%, 2W
28.5 VAC-P2-13
28.5 VAC-P2-14
CR23 IN1124R
CR24 IN1124R
(1V) -30V- P2-8
(1V) -12V- P2-10
(0.5V) +18V- P2-9
F1, 2AMP 3AG, SLO BLO
F2, 2AMP 3AG, SLO BLO
F3, 2AMP 3AG, SLO BLO
R7 1MEG ±10% 1/2W
C1
CR17
CR18
CR25 IN1124R
CR26 IN1124R
CR27 IN1124R
CR28 IN1124R

REVISIONS				
SYM.	EFFECT.	DESCRIPTION	DATE	APPROVAL



→ P2-2, GND

→ P2-22, CHASSIS GND

→ P1-11, +35V (150MV)

→ P2-20, 28 VAC

→ P2-19, 28 VAC

→ P2-11, 13 VAC

→ P2-12, 13 VAC

10070-119
SHEET 2

5. TYPICAL PEAK-TO-PEAK RIPPLE VOLTAGE MEASUREMENTS ARE SHOWN IN PARENTHESES. ALL VOLTAGES ARE MEASURED WITH RESPECT TO PIN 7 OF P1.
4. DO NOT UNPLUG RECTIFIER BOARD FROM MAIN BOARD UNTIL AT LEAST TWO MINUTES HAVE ELAPSED AFTER TURNING POWER OFF; THIS ALLOWS THE ELECTROLYTIC CAPACITORS TO DISCHARGE.
3. CAUTION: HIGH VOLTAGE PRESENT ON RECTIFIER BOARD.
2. IN3047B DIODE IS 130V ZENER.
1. ALL DIODES ARE IN2616.

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

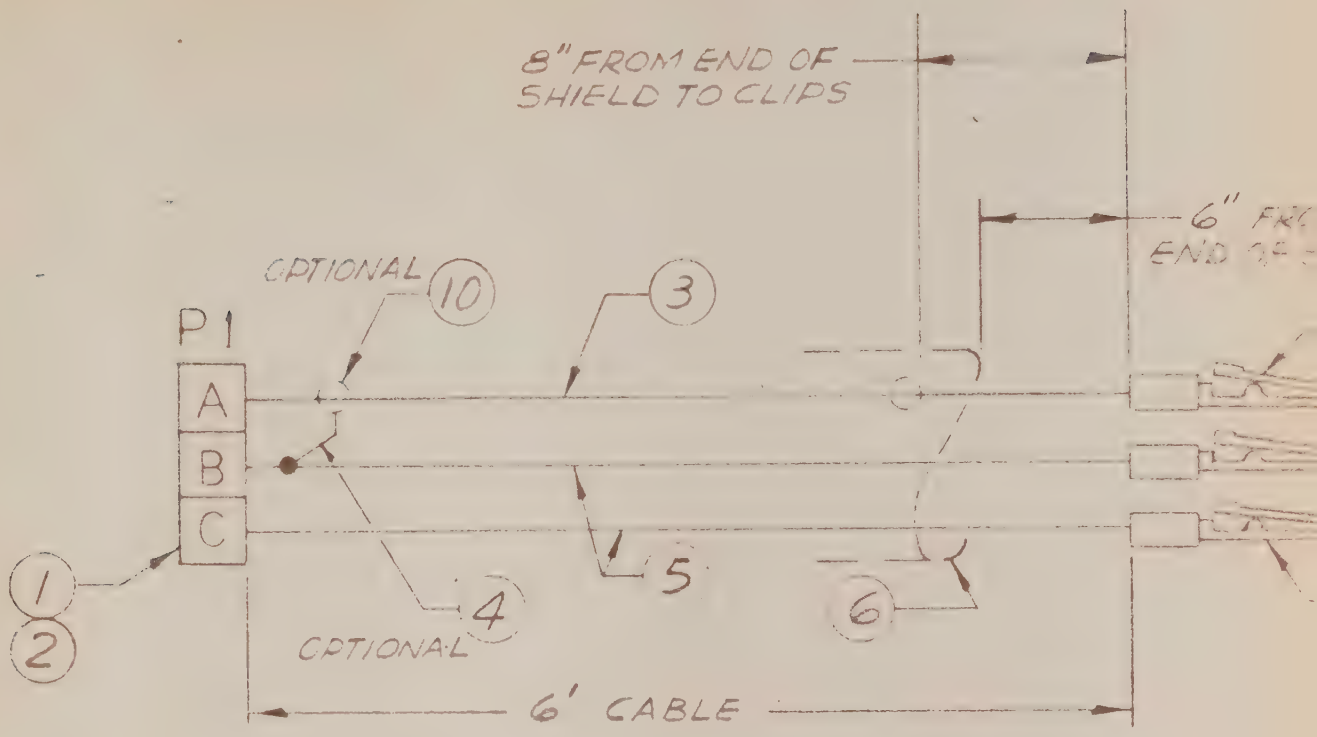
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTION ± DECIMAL ± ANGLES ±
MATERIAL
FINISH

DRAWN BY H. BRINLEY DATE 1-16-62
CHECKED BY DATE
APPROVED BY R. JOHNSON DATE 2-21-62

TITLE
SCHEMATIC, RECTIFIER
MODEL M25
SCALE WT.

NON-LINEAR SYSTEMS INC.
DEL MAR AIRPORT
DEL MAR, CALIFORNIA

DRAWING NUMBER
10070-119
SHEET 2 OF 2



ITEM	REQ'D	PART NUMBER
10	1	-3932
9	1	300
8	1	297
7	1	337
6	A/R	V105
5	A/R	#20 AWG
4	A/R	#22 AWG
3	A/R	RG122/U
2	1	AN3057-6A
1	1	97310GA 45-75

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTION ± 1/2" DECIMAL ± ~ ANGLE ± ..
MATERIAL

NOTES:

4. STAMP SYMBOL (P1) ON SLEEVING NEAR CONNECTOR.
3. STAMP PART NO. (15004-075) ON SLEEVING.
2. CABLE TO BE TESTED FOR I.R. BETWEEN PINS B & C AND BETWEEN PINS B & C AND SHELLS OF BOTH CONNECTORS. I.R. TO BE 100 MEGOHMS MINIMUM AT 500V.
1. CABLE TO BE TESTED FOR I.R. BETWEEN PINS A & B, A & C ALSO BETWEEN PIN A AND SHELLS OF BOTH CONNECTORS. I.R. TO BE 200,000 MEGOHMS MINIMUM AT 500V.

15004-075 5

REVISIONS				
SYM	EFFECT.	DESCRIPTION	DATE	APPROVAL
5	M25.1 EM24 10.812	REVISED & REDRAWN FROM "A" SIZE DWG.	10-13-61 HLB	10-17-61 R

EVE TO CLIPS

7) SIGNAL INPUT

8) SIGNAL COMMON

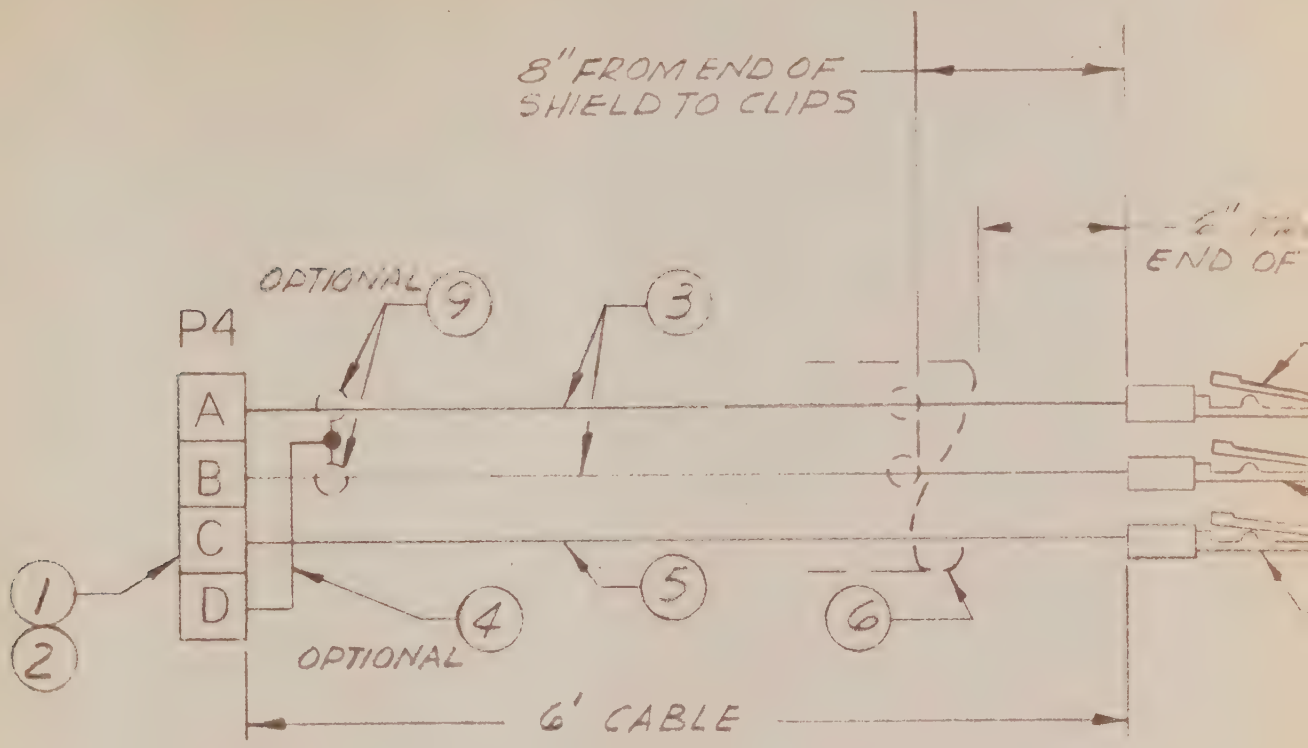
CHASSIS GROUND

9)

DESCRIPTION	MATERIAL OR MANUFACTURER	NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
TERMASHIELD	AMP				
CLIP (UNINSULATED)	H.H. SMITH				
CLIP (BLACK)	H.H. SMITH				
CLIP (RED)	H.H. SMITH				
SLEEVING, VINYL - 1/4" I.D., ILLUMITRONIC (BLK)					
WIRE, STRANDED - BLACK					
WIRE, STRANDED - BLACK (#24 PERMISSIBLE)					
COAXIAL					
CLAMP		10070	10070	1	1
26 CONNECTOR	AMPHENOL	10050	10050	1	1
		APPLICATION		QTY REQD	

LIST OF MATERIALS

DRAWN BY H. BRINLEY	DATE 10-6-61	TITLE	NON-LINEAR SYSTEMS INC.
CHECKED BY	DATE	CABLE, INPUT	DEL MAR AIRPORT
APPROVED BY A. JOHNSON	DATE 10-13-61		DEL MAR, CALIFORNIA
FINISH		MODEL 20 SERIES	DRAWING NUMBER 15004-075
		SCALE NONE WT.	SHEET OF



ITEM	REQ'D	PART NUMBER
10	1	337
9	2	337 #2
8	1	337
7		337
6	A/R	V105
5	A/R	#20 AWG
4	A/R	#22 AWG
3	A/R	RG122/U
2	1	AN3057-6A
1	1	973106A-14S-2S

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTION ± 1/2" DECIMAL ± — ANGLE ± —
MATERIAL

3. STAMP SYMBOL (P4) ON SLEEVING NEAR CONNECTOR.
2. STAMP PART NUMBER (15004-077) ON SLEEVING.
1. CABLE TO BE TESTED FOR I.R. BETWEEN ALL PINS AND BETWEEN ALL PINS AND SHELLS OF BOTH CONNECTORS. I.R. TO BE 100 MEGOHMS MINIMUM AT 500V.

NOTES:

15004-077 4

REVISIONS				
SYM	EFFECT	DESCRIPTION	DATE	APPROVA
4	M25.1 & M24 10.8.2	REVISED & REDRAWN FROM "A" SIZE DWG.	10-13-61	

M
LEEVE TO CLIPS

(7)

+REFERENCE

-REFERENCE

(10)

REF. GROUND

(8)

DESCRIPTION	MATERIAL OR MANUFACTURER	NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
CLIP(RED & BLK)	H.H. SMITH				
TERMASHIELD	AMP				
CLIP(BLACK)	H.H. SMITH				
CLIP (RED)	H.H. SMITH				
SLEEVING, VINYL-[illegible] I.D., ILLUMITRONIC (BLK)					
WIRE, STRANDED - BLACK					
WIRE, STRANDED - BLACK (#24 PERMISSIBLE					
COAXIAL					
CLAMP		10070	10070	1	1
426 CONNECTOR	AMPHENOL	10050	10050	1	1
		APPLICATION		QTY REQD	

LIST OF MATERIALS

DRAWN BY H. BRINLEY — DATE 10-13-61
CHECKED BY — DATE
APPROVED BY [signature] — DATE 10-17-61
FINISH

TITLE

CABLE, EXTERNAL REFERENCE

MODEL 20 SERIES

SCALE — WT.

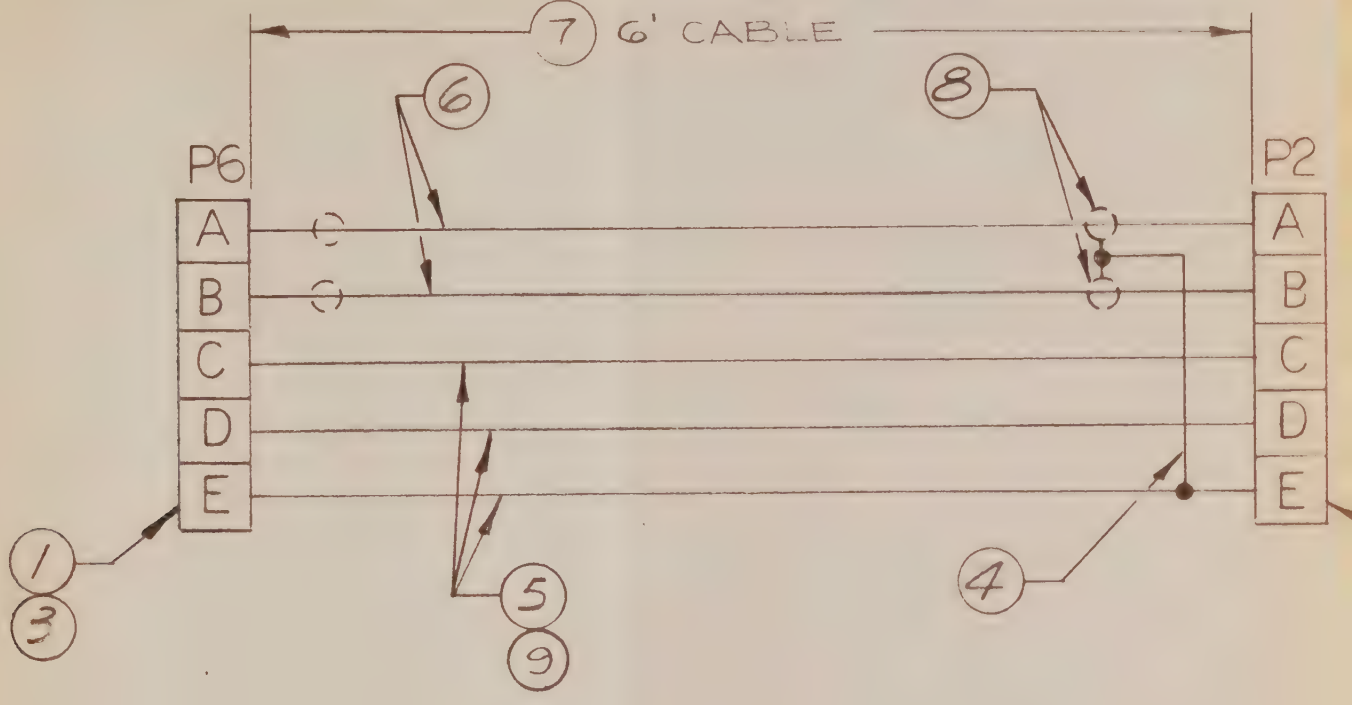
NON-LINEAR SYSTEMS INC.
DEL MAR AIRPORT
DEL MAR, CALIFORNIA

DRAWING NUMBER 15004-077

SHEET — OF

5 E

MANUFACTURERS LIST	
AMPHENOL	CHICAGO, ILL.
AMP INC.	HARRISBURG, PA.
ILLUMITRONIC ENGINEERING CO.	SUNNYVALE, CALIF.



ITEM	REQ'D	PART NUMBER
9	A/R	QQ-S-571
8	2	323932
7	A/R	V105
6	A/R	RG122/U
5	A/R	#20 AWG
4	A/R	#22 AWG
3	2	AN3057-6A
2	1	9731064-145-5
1	1	9731064-145-53

6. SOLDER PER MIL-S-6872.

5. 15004-078 AS SHOWN, 6' CABLE; -078-1 IS 9'.
4. STAMP SYMBOLS (P2 & P6) ON SLEEVING NEAR ASSOCIATED CONNECTORS.
3. STAMP PART NO. (15004-078) ON SLEEVING.
2. CABLE TO BE TESTED FOR I.R. BETWEEN PINS C&D, C&E, D&E, ALSO BETWEEN PIN C, D&E AND SHELLS OF BOTH CONNECTORS. I.R. TO BE 100 MEGOHMS MIN AT 500V.
1. CABLE TO BE TESTED FOR I.R. BETWEEN PINS A&B, A&C, A&D, A&E, B&C, B&D, B&E; ALSO BETWEEN PINS A& SHELLS OF BOTH CONNECTORS, PIN B & SHELLS OF BOTH CONNECTORS. I.R. TO BE 100,000 MEGOHMS MIN AT 500V.

NOTES:

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

TOLERANCES ON		
FRACTION	DECIMAL	ANGLE
± 1/2"	±	±

MATERIAL

H4-03-20

15004-078

REVISIONS				
SYM.	EFFECT.	DESCRIPTION	DATE	APPROVAL
4	M25.1 ⁄ M24 10.812	REVISED & REDRAWN FROM "A" SIZE DWG.	10-18-61 HBB	
5	use. 10459a	ADDED NOTE 5 CREATING -1	1-4-62 AKW	
6	ALL	ADDED ITEM 9 & NOTE 6 ADDED MFG LIST	4-24-62 R W.	

(2)
(3)

DESCRIPTION	MATERIAL OR MANUFACTURER	NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
SOLDER					
TERMASHIELD	AMP				
SLEEVING, VINYL 5/16 I.D., ILLUMITRONIC (BLK)					
COAXIAL					
WIRE, STRANDED - BLK					
WIRE, STRANDED - BLK (#24 PERMISSIBLE)					
CLAMP		10086	10086	1	1
426 CONNECTOR	AMPHENOL	10070	10070	1	1
426 CONNECTOR	AMPHENOL	10050	10050	1	1

LIST OF MATERIALS — APPLICATION — QTY REQD

DRAWN BY H. BRINLEY — DATE 10-18-61
CHECKED BY — DATE
APPROVED BY R. JOHNSON — DATE 10-19-61
FINISH

TITLE

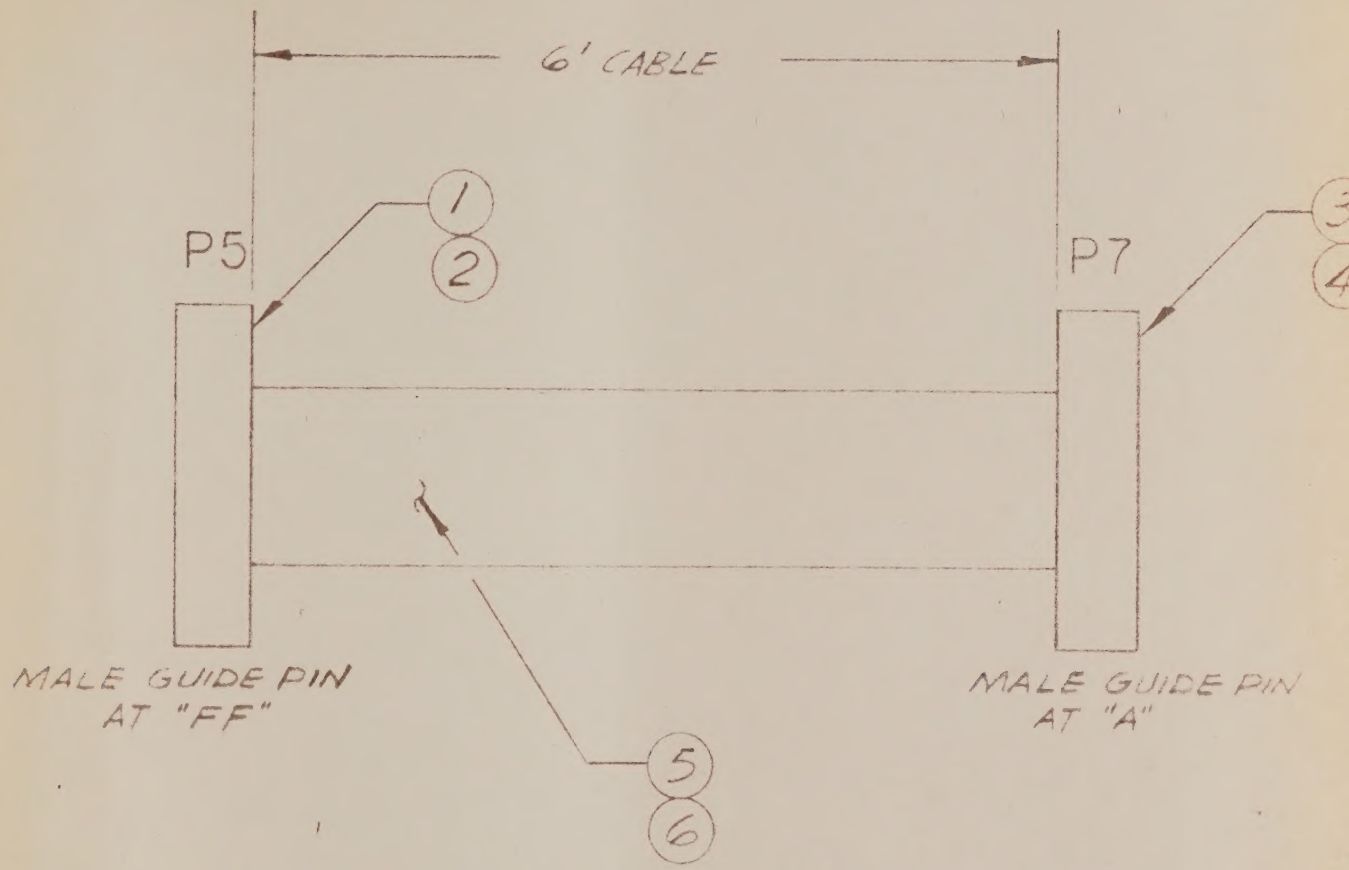
CABLE, REFERENCE

NON-LINEAR SYSTEMS INC.
DEL MAR AIRPORT
DEL MAR, CALIFORNIA

DRAWING NUMBER 15004-078

SCALE NONE — WT. —

SHEET 1 OF 1



ITEM	REQ'D	PART NUMBER
6	A/R	V105
5	A/R	8750
4	50	97502
3	1	2024-005
2	50	97503
1	1	2024-004

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTION ± 1/2 DECIMAL ± ~ ANGLES ±
MATERIAL

NOTES:

1. CONTACTS TO BE WIRED A TO A, B TO B, C TO C, . . . ETC.
2. STAMP PART NUMBER (15004-079) ON SLEEVING.
3. STAMP SYMBOLS (P5 & P7) ON SLEEVING NEAR ASSOCIATED CONNECTOR.

15004-079 4

REVISIONS

SYM	EFFECT	DESCRIPTION	DATE	APPROVAL
4	M25.1 & M24 10.812	REVISED & REDRAWN FROM "A" SIZE DWG.	10-17-61 HDB	10-17-61 R.V.S

DESCRIPTION	MATERIAL OR MANUFACTURER	APPLICATION NEXT ASSY	APPLICATION USED ON	QTY REQD NEXT ASSY	QTY REQD FINAL ASSY
SLEEVING, VINYL 5/8" I.D. ILLUMITRONIC (3/4" I.D. PERMISSIBLE)					
CABLE, MOHAWK (22 AWG STRANDED, 50 PCS., ALTERNATE)					
SOCKETS	C.E.C.				
CONNECTOR					
PINS	C.E.C.	10070	10070	1	1
CONNECTOR		10050	10050	1	1

LIST OF MATERIALS

DRAWN BY H. BRINLEY — DATE 10-17-61
CHECKED BY — DATE
APPROVED BY R. Johnson — DATE 10-17-61
FINISH

TITLE

CABLE
POWER & LOGIC

NON-LINEAR SYSTEMS INC.
DEL MAR AIRPORT
DEL MAR, CALIFORNIA

DRAWING NUMBER 15004-079

SCALE NONE — WT. — SHEET — OF

non linear
systems, inc.

DEL MAR, CALIFORNIA

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